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Advertisement Index, see page xxviii.

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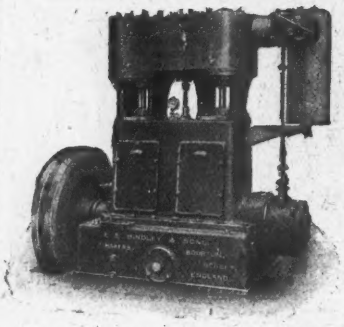

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THE

ELECTRICAL REVIEW.

VOL. LXXX. JUNE 15, 1917. No. 2,064.

ELECTRICAL REVIEW.

Vol. LXXX.] CONTENTS: June 15, 1917. [No. 2,064.

	Page
Speed the Plough Electrically	641
The Conditions of Labour	642
Recent Developments in Electricity Supply at Keighley, by H. Webber (*illus.*)	643
Anthracite Coal, by W. H. Booth	646
New Electrical Devices, Fittings and Plant (*illus.*)	647
Legal	648
Correspondence—	
Business Man or Engineer?	649
News from Ruhleben	650
Association of Consulting Engineers (Inc.)	650
War Items	650
Business Notes	652
Notes	655
City Notes	658
Stocks and Shares	660
Induction Methods of Fault Localisation, by H. E. Blake (*illus.*)	661
The more Recent Applications of Electricity in the Present War, especially in the Treatment of Diseases and Wounds arising therefrom, by W. Leeming (*illus.*)	661
An A.C. Bridge Method of Comparing Inductances, by T. Parnell (*illus.*)	664
New Patents Applied for, 1917	664
Abstracts of Published Specifications	664
Contractors' Column	Advertisement page xxii

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SPEED THE PLOUGH ELECTRICALLY.

No apologies are needed at the present time, even in the case of an electrical paper, for referring to the subject of ploughing, which is a matter not only of domestic, but of very real national concern. The country had been led to expect much from the influx of petrol-motor operated tractors and ploughs on our farms, and in view of the eulogistic forecasts of their friends and admirers it is rather a shock to learn from the *Commercial Motor*, which is naturally an ardent supporter of the movement, that the "initial" experiments in their use under official auspices have proved rather disappointing; "the troubles have much exceeded anticipations" . . . "the average ploughing per month per agrimotor has been very much below the most conservative estimates of the promoters," and that "the figures . . . are startling by reason of their disclosure of low average performance per agrimotor."

Putting aside the questionable suggestion of novelty—the manufacture of farm tractors has been proceeding for some years—we must express our regret that the expectations as regards the assistance to be obtained from these internal-combustion-engined farm appliances in extending our home food production in the emergency conditions of the moment are unlikely to be realised. Private issues are beside the question, and had the motor-tractor and plough come through victoriously criticism would have been ungenerous. When, however, the Editor of the *Commercial Motor* contents himself by taking the view that the bringing under the plough of an additional three million acres of land, which it is sought to accomplish during the next 12 months, will largely be aided by the employment of additional steam ploughing sets, assisted by motor tractors, &c., and suggests that 100 such sets might be constructed between now and the end of the year, although he would be glad to see even 50 additional ones, which would represent at least 150,000 acres of new ploughing and cultivating per annum—for which work not fewer than 400 independent agrimotors were be required, based on an annual average per machine, with double shift working, of 375 acres—we begin to realise how very far from providing a solution to the ploughing difficulty the present types of motor-tractor and plough really are.

Assuming that we must revert to some form of cable ploughing to attain our object, we would suggest that much of the constructive difficulty and first expense (over £4,000 per steam set) would be obviated by adopting electricity as a power agent wherever a suitable supply of electricity is practicable, instead of building independent steam engines, with their attendant fuel and water carrying difficulties. Standard electrical motors and apparatus can be used for haulage gears, costing far less than engine-driven gears, and extremely light pole line construction would meet the conditions on private property, the power required being comparatively insignificant from a transmission point of view. In addition, a supply of electricity means good lighting at night, thus allowing of continuous day and night ploughing, and as one cannot overlook the favourable prospects of increasing crop production on the same land, or alternatively utilising less land and fewer ploughs, by employing electro-cultural-methods, it appears that a strong case can be

made out for the electric plough plus electroculture.

The greatest obstacle in the way of such a scheme to the non-technical mind is lack of electricity supply on the spot; yet anyone who has visited large reservoir and dock works in progress, covering square miles of land, must have been struck with the facility with which temporary transmission lines are erected or moved at a few hours' notice, and no engineer who is practically familiar with such work would doubt the possibility of developing a suitable system for ploughing purposes.

We are not advocating an untried novelty; readers who are interested will find many references to electrical ploughing results in past volumes of the Review, including an illustrated article on the use of the electric plough on a farm in Nottinghamshire,* but apart from this, we have the electric ploughing experience of the German firms, Eckert, Siemens, A.E.G., &c., the Italian firms, such as the Société Electrotechnique of Turin, and Morelli, and again of the French Société de Constructions Electriques (Jeumont), and of M. Fillet to draw upon, the latter in particular having developed a portable field transmission system employing light tubular poles which are screwed into the ground, and easily packed into a wagon for removal.

The electric plough was tried out before the oil tractor and plough had emerged from the nursery, and it is very evident that had the electrical fraternity in this country displayed a quarter of the energy shown by the internal-combustion engine enthusiasts, the possibilities of electrical ploughing in some districts, at least, would have received official recognition, and the costly coal-burning steam tackles could be relegated to less favoured localities. The circumstances of the moment have left the electrical industry with trump cards in the shape of the electric plough and electroculture. But with an industry which is apathetic and casual in matters affecting organised development work, and a Government agricultural department which has only recently emerged from a prolonged state of coma, it will probably require something of the nature of T.N.T., suitably applied, to awaken either to a realisation of the economic future before electric ploughing.

The Conditions of Labour.

Those of our readers who are interesting themselves in after-the-war conditions of Labour, and who recognise the importance of doing everything possible to avoid causes of future friction, may be advised to obtain a copy of a pamphlet just issued by the Labour Co-Partnership Association (6, Bloomsbury Square, London, W.C.) on the subject of "Industrial Fatigue in its relation to Maximum Output." Brief introductory messages are contributed by Sir Robt. A. Hadfield and Mr. J. R. Clynes, M.P., the former quoting his own experience in proof of the inadvisability of employing non-stop and overtime methods, and showing that by knocking off Sunday work output was not reduced. Sir Robert does not care for Taylorism because of its tendency to make the workman into a machine, when, after all, he is a human being. Mr. Clynes states three outstanding impressions which are in the minds of workmen. When changes have been made to secure increased output, the men have felt certain that such changes would mean reduced wage rates, "and their certainty rested upon experience." "They were confident that the more they produced the sooner they would be unemployed, and they found results in some occupations to support this view." "They had a natural objection to being made the mere instruments for certain unknown material ends which would give greater gain to others than they themselves derived." He holds that there will be difficulty in getting rid of these deeply-rooted impressions which have been engendered as the result of generations of industrial experience, and in his opinion it will not do to try and reduce the conditions of fatigue purely "in order that workmen should be able to produce more." That would be one of the results, but to set it up as an object would be fatal. Though he recognises that increased production is all-important, he feels that it should be secured with two other conditions: (*a*) A fair share of the increased rewards should go to the producer; (*b*) the producer himself must be regarded as a man first, and a workman afterwards. These are merely the introductions to the pamphlet, in which very thoughtful views on the subject of fatigue and output are expressed by Prof. Henry J. Spooner. The conditions of industrial life, in Government-owned and controlled factories and yards, during war-time have taught us more than we ever knew in practice before concerning the matter. Prof. Spooner deals with the subject in the light of this and other valuable experience, and he handles it sympathetically, setting forth a collection of notes which form as comprehensive a study of the whole matter as one could reasonably hope for in a pamphlet of 50 or 60 small pages, and one which can very appropriately be studied at the present time. The causes of fatigue are many, and Prof. Spooner discusses a variety of means which may be employed, without any appearance of "fussiness" or coddling, to remove these causes. The points touched upon include the need for healthy environment in the works, the provision for periodical rest breaks, avoidance of overtime and Sunday work, reduction of working hours, simplification of operations and lightening of labour as the result of motion study, the scrapping of antiquated machinery and methods, the re-classification of certain trades, education respecting the worker's fallacy concerning the benefits to himself of restriction of output, study of the conveniences and conditions of the workers, both within and outside the factory, the need for better housing accommodation, especially in crowded industrial centres, &c. The worker calls for greater security of employment, and if this can be secured it will benefit the employer by obviating the wasteful turn-over of trained labour from one works to another, which the unwisdom of the hasty discharge of labour is bound to encourage. The author is under no delusion as to the urgency of our industrial problems, nor is he blind to the unlimited industrial expansion that lies awaiting us. He obviously attaches great importance to the question of Welfare Work, and urges the cultivation of the long vision. In his opinion, some of our great statesmen, engineers, and industrials, who are not now fully employed on matters of national interest, should be appointed to carefully examine the problems of the kind indicated above while there is time. The Government Labour Unrest Commissioners who are now getting to work in different areas of the Kingdom have a very large subject to investigate. Their task has arisen directly from war conditions, and what they are to suggest in their recommendations relates, we believe, more particularly to the measures necessary for removing the special causes of unrest for the further period of the war. Prof. Spooner's method of dealing with the subject, as well as the Labour Unrest Commissioners' study, both have a direct bearing upon the after-the-war industrial situation. It is on that ground that we commend them to the attention of serious students of our industrial problems.

* Electrical Review, February 11th, 1916.

RECENT DEVELOPMENTS IN ELECTRICITY SUPPLY AT KEIGHLEY.

By HARRY WEBBER, A.M.I.E.E., Borough Electrical Engineer and Tramways Manager.

The following article is intended, not only to give particulars of the extensions to the Keighley electricity works, which were officially opened by the Mayor of Keighley (F. W. L. Butterfield, Esq., J.P.) on May 31st, 1917, but also to illustrate the effect that the present European war has had on the supply of electricity in the town generally.

My excuse for preparing the article is that I believe many of the particulars and the special information given will be of use to a great number of readers.

The Keighley electricity undertaking was inaugurated in 1901, and a supply was commenced on March 30th of that year. The plant consisted of two Lancashire boilers, with a total heating surface of 1,932 sq. ft.; three Allen engines of 730 I.H.P. direct-coupled to three Allen dynamos with 440-KW. output, with a small Tudor battery.

The capital expended was £39,300, detailed as follows:—Buildings, £7,000; generating plant, £12,000; motors and instruments, £21,000; mains, £14,100; accumulators, £2,000; public lamps, £1,556.

The station was originally intended for supplying power for the tramways, which had just been electrified, and also any lighting developments which might occur.

Nothing of a very exceptional character was done in the way of expanding the business until the latter end of 1909, when the plant capacity had then increased to 740 KW.

Seeing that more plant had to be installed, the question of a complete change in the methods of generation was fully discussed by the Electricity Committee, with the result that application was eventually made to the Local Government Board for permission to borrow £21,000 in order that a three-phase, E.H.T., alternating-current system of supply could be commenced for the power users in the town of Keighley. Since this time the undertaking has forged ahead.

There was a steady increase in the output of units from 1910, when the total sale was only just over 100,000 units, until 1914, the year when the present war commenced, of just over 4,000,000 units.

To show the effect the war has had on the output, the total sale at the present time is at the rate of just over 8,000,000 units per annum, or double what was being sold when the war first broke out.

The original turbine units installed were only of 1,000-KW. capacity, whereas the latest installation is of 5,000-KW. capacity, the total plant capacity at the present time being, in round figures, 10,000 KW.

The capital either spent or pledged up to March 31st, 1917, amounted to about £146,000; this figure includes the cost of the latest new plant and also £9,300 for land, as well as all the mains, meters, motors on hire, engine-room and boiler-house plant. Working this out on the kilowatt capacity, it only amounts to £15·38 per KW., which is an exceptionally low figure; moreover, there is very little plant of an obsolete nature left, as all the Lancashire boilers and two out of three of the original generators have been sold, and the balance of cost paid for out of revenue.

No doubt one of the primary reasons why the Keighley undertaking has developed very rapidly since the installation of the three-phase system, is that in conjunction with this system a very moderate charge was made for the supply of energy in bulk—namely, £3 per KW. of maximum demand, plus ¼d. for every Board of Trade unit consumed. This has brought the average price obtained to ·86d. per unit, which is lower than in many large towns and cities with a much greater output in units sold.

I believe, however, that the policy of offering this low price has been justified, as it was not until the year 1912 that the department first began to make a profit, and this profit, which was only small at the commencement, has gradually increased, until the exceptional cost of materials, &c., for the last two years has brought it slightly lower again.

In the initial stages it was obvious that although pretty heavy prices were being charged, the current was being sold at a loss; thus in the year 1902 the total costs were 10·1d., while the average price obtained was only 3·1d.; that is to say, a loss of 7d. resulted on every unit that was sold. In 1903, 4d. was lost on every unit sold, and the third year 2½d., and so on until 1912, when the costs of production were exactly equal to the average price obtained.

Low prices could not be maintained unless the working costs and capital expenditure were kept at a very low figure. To illustrate what these figures have been, in 1914, just before the war commenced, the total working costs averaged only ·47d. and the total capital charges ·32d. per unit.

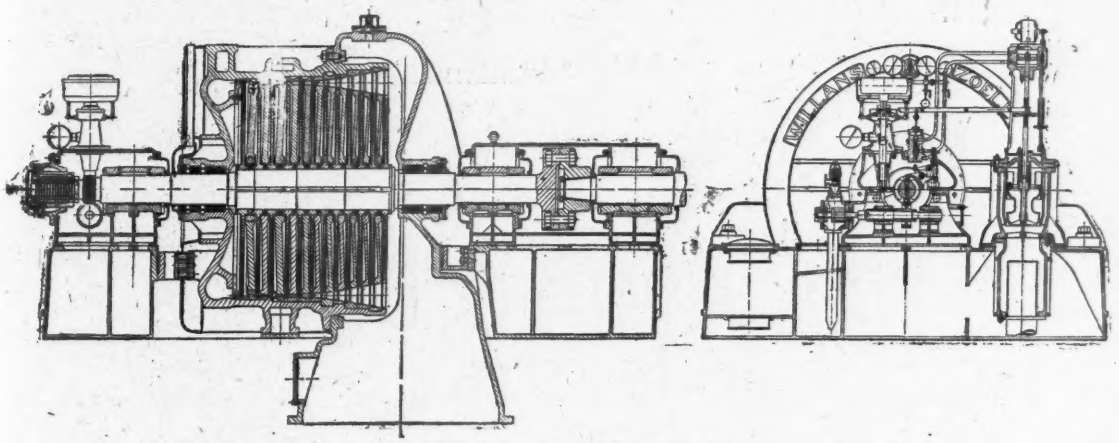

Fig. 1.—Section through 5,000-KW. Willans-Zoelly Turbine at Keighley.

The demand is created by a very diversified class of manufactures, and this has a beneficial effect on the power station, as it results in a very steady load throughout the majority of the working day, thus enabling boilers and prime movers to be worked at their most efficient output.

The following is a selection of power consumers connected to the mains:—Small wood turners, wringing machine manufacturers, tape manufacturers, machine tool makers, corn millers, saw mills, weaving sheds, spinning mills, steel founders, malleable iron founders, brass founders, dyers, coopers, cabinet makers, manufacturers of spinning machinery, loom makers, paper tube manufacturers, tanners and curriers, laundries, automobile works, manufacturers of electrical plant, stone yards, brewers and maltsters, wagon works, hosiery manufacturers, bakeries, &c.

The following examples of power consumers on the Keighley supply may be of interest to readers:—

Malleable Iron Founder.—D.C. supply, £21 per month; seven motors installed, total 76 H.P.

Iron Works.—D.C. supply, £26 11s. 4d. per month. Principal manufactures, washing machines and bedsteads; 11 motors installed, total 97 H.P.

Wagon Builder.—D.C. supply, £2 8s. per month; six motors installed, total 36 H.P.

Sand Merchant.—D.C. supply, £2 13s. 8d. per month; two motors installed, total 23 H.P.

Corn Miller.—A.C. supply, £9 5s. per month; two motors installed, total 50 H.P.

Timber Merchant and Sawyard.—D.C. supply, £3 13s. per month; six motors installed, total 46 H.P.

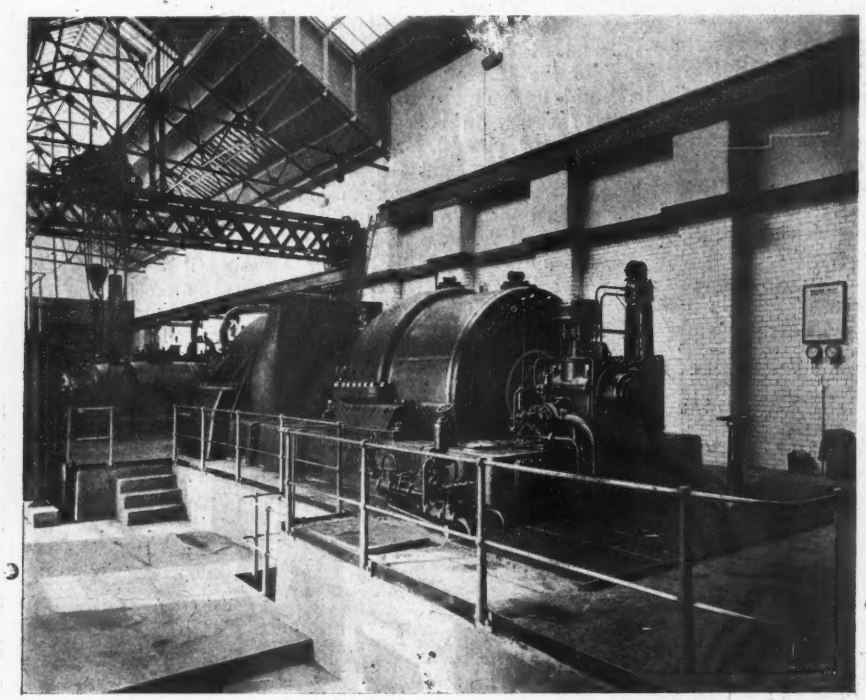

FIG. 2.—WILLANS-ZOELLY G.E.C. TURBO-ALTERNATOR INSTALLED AT KEIGHLEY.

Machine Tool Maker.—A.C. supply, £21 17s. per month; 14 motors installed, total 175 H.P.

Brass Finishing, including Foundry.—D.C. supply, £12 7s. per month; five motors installed, total 41½ H.P.

Weaving Sheds.—A.C. supply, £39 per month; 275 looms and one winding frame; five motors installed, total 130 H.P.

A.C. supply, £16 9s. per month; 130 looms and one hoist; five motors installed, total 100 H.P.

A.C. supply, £9 per month; 22—86-in. broad looms; one motor installed of 25 H.P.

A.C. supply, £25 per month; 480 tape weaving machines and 10 beaming and winding machines; three motors installed, total 90 H.P.

Hosiery Manufacturer.—D.C. supply, £4 9s. per month; 20 hosiery machines and 28 sewing machines; two motors installed, total 14½ H.P.

Spinning and Twisting Machines.—A.C. supply. £13 per month; 144 cap spindles, 700 fly spindles, 132 ring twisting spindles, and 96 fly twisting spindles; one motor installed of 35 H.P.

Foundry.—D.C. supply, £8 2s. per month; five motors installed, total 56½ H.P.

During the year 1914, powers were obtained to supply a large area surrounding the borough on all sides, but a clause was inserted restricting the Corporation from commencing the work of laying mains, &c., until six months after the declaration of peace. With these additional districts, practically the whole of the Valley of the Worth and a good portion of the Aire Valley will be included in the supply area, and I estimate that at least 30,000 steam H.P. is being produced in those districts at the present time by private concerns, which in the natural course of events may reasonably be expected to take a supply eventually from the Corporation.

One of the districts which obtained its own provisional order is already taking a supply in bulk, and transforming it for tramway and general distribution purposes.

I now propose to give a detailed description of the recent extensions.

The prime mover is a 5,000-KW. Willans-Zoelly steam turbine, which is direct coupled to an alternator made by the General Electric Co.

The turbine is of rather special interest, as it is practically the first Zoelly-type steam turbine made by Messrs. Willans and Robinson, and is similar to the sets which have been installed at the Glasgow Corporation electricity works and Salford Corporation electricity works.

The surface condensing plant, which was also supplied by Messrs. Willans & Robinson, has a special feature, which is of interest—namely, that the air, instead of being extracted by some form of rotary or reciprocating plant, is carried away by passing the whole of the circulating water through ejectors, before entering the condenser proper. This system does away with one piece of moving plant, thus saving the usual upkeep, and also the power which is always required for driving the ordinary types of air pumps; moreover, it is not so liable as machinery in motion to give trouble whilst in operation.

The governor is of the oil relay type, and is fitted with a small motor, which can be controlled from the switchboard gallery, so that in the event of the attendant on the engine-room floor not being available at the moment, the speed can be brought up or down by the switchboard staff. In Keighley, however, this has not been coupled up, as once the load is on after meal hours, it is so steady that the set very seldom varies in speed at all.

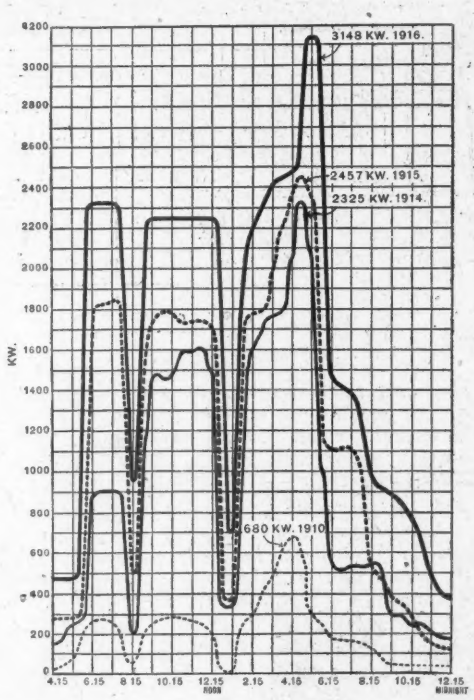

FIG. 3.—KEIGHLEY LOAD CURVES, 1910, 1914, 1915 AND 1916.

With the majority of steam turbines running at high speeds there is always the possibility that the bearings become dry after the plant has been standing for some time. Some makers provide oil rings, which operate by friction on

the shaft; other makers provide a small hand semi-rotary pump, which the engine driver is supposed to work before starting the set up, and thus flush the bearings by hand, but I think the arrangement adopted on the set described is preferable to either of these methods. A small steam oil pump is coupled in with the rotary pump driven from the turbine itself, and immediately steam is turned on to the main stop valve, this steam pump starts automatically to flush the bearings with oil. When the turbine is fairly up to speed a diaphragm device cuts out the steam pump, and leaves the oil circulation entirely to the rotary pump.

The steam pump also comes into operation again whilst the set is gradually slowing down.

All so-called flexible couplings have been eliminated in the designing of this set, the alternator rotor being rigidly coupled to the steam rotor, and the exciter armature is built on to the end of the main shaft.

The modifications eliminate a lot of the minor troubles which are generally experienced some time or other with flexible couplings, and small bearings for the exciter when flexible couplings are used.

The turbine proper is of the multi-cellular impulse type, consisting of a rotor, on which is mounted the required number of impulse wheels, each of these wheels rotating in a separate chamber formed by means of division or diaphragm plates.

FIG. 4.—STEAM END, 5,000-KW. WILLANS-ZOELLY TURBINE SET, KEIGHLEY.

The body is built up of ring sections permanently bolted together, but divided into upper and lower halves. Feet are fitted on to this body, which enable it to slide along the bed plate, and thus allow for unequal expansion. The main pedestals are cast entirely separate from the body, and so arranged that the alignment of the turbine is unaffected by the expansion of any of its parts.

The steam rotor consists of a steel forging which forms the shaft, upon which are mounted the disks, of high-tensile steel, each fitted with one row of nickel steel impulse blading.

The roots of these blades are of T-section fitted into grooves and machined in the disk, and shrouding is fitted round the periphery.

The casing is subdivided by diaphragm plates, fitted with labyrinth packing to prevent leakage of steam from stage to stage. The steam passages are formed at the outer edge of these diaphragms by plates of nickel steel, cast in position.

A set of small thrust collars is provided, which would be capable of taking a heavy end thrust, if necessary, but is really intended to be used only for adjusting the position of the shaft when first setting to work. This thrust block is rigidly attached to the turbine body, and free to slide in the steam-end pedestal.

The oil is cooled by means of two vertical coolers, coupled up in series, but of such a size that it would be possible under emergency circumstances to run the turbine whilst one was being cleaned out.

Besides the ordinary governor, which has already been described, there is an emergency governor, which comes into action when the maximum allowable speed of the turbine has been exceeded.

As far as possible the steam connections, oil pipes, &c., have been fitted to the lower portion of the turbine body, so that when an internal inspection is necessary, there is practically only the cover or top half of the body to lift, without undoing a lot of pipe connections, and other small apparatus.

The condenser is designed to maintain a vacuum of 28½ in. when the turbine is on full load, and the barometer stands at 30 in., the quantity of water required to obtain this vacuum being 5,180 gallons per minute at a temperature not exceeding 60° F.

The cooling surface provided is 7,740 sq. ft. A flooding cock is specially fitted, so that the steam space in the condenser can be filled with water if it is desired to run the turbine non-condensing. This saves installing one of those huge valves, which generally result in a continuous loss of vacuum through slight air leaks.

The condenser itself is erected immediately below the turbine bedplate, with a sufficient gap between the flange of the exhaust end of the turbine and the steam flange of the condenser to allow for a suitable expansion piece.

The electrical end constructed by the General Electric Co. is designed to give an output of 5,000 KW. continuously at 6,600 volts, 50 cycles, with a power factor of ·8 and a speed of 1,500 R.P.M.

The generator stator is in one piece, and consists of a cast-iron box section frame to accommodate the laminations.

No filing or scraping was done after the laminations were assembled, as owing to the length this would cause much higher iron losses, due to eddies, than in ordinary machines. For the same reason, sheets of strong paper are inserted between the plates at suitable intervals.

Stranded copper has been used throughout, not only in the slot, but also in the connections.

The insulating tubes are of micanite, and moulded on to the coil itself.

The ventilation is carried out by means of fans fixed rigidly at each end of the rotor, and the scheme is that the fan at the exciter end of the rotor drives the air into the space enclosed by the guards. After cooling this side of the stator coils, the air passes through a number of axial channels provided in the core for cooling purposes. The outlet for the air is all at one end of the machine; that is to say, the opposite end to the inlet, and in passing through the core to escape, it automatically cools the coil connections. There are two completely separate streams of air, and that air which is used to cool the rotor is not used again to cool any part of the stator; this results in very low even temperature rises all over the machine.

D

Heavy metal clamps are arranged all round the windings to prevent any moving of the connectors or the projecting ends of the coils.

The rotor is a solid forging, in one piece with the shaft; the slots are milled out of the solid drum.

The fan at the coupling end of the rotor is used for keeping a circulation of air through the rotor for cooling purposes.

The temperature rise guarantee is that it shall not exceed 70° above the surrounding atmosphere after six hours' run on full load. Efficiencies at ·8 power factor full load, 95·75; three-quarter load, ·95; half-load, 93·25.

With relation to the overall efficiency of the set, as a result of some recent tests taken on site, it was found that the steam consumption per KW.-hour is ·6 lb. better than the maker's guarantee, which was considered most satisfactory.

A Heenan & Froude rotary air filter is installed in connection with the alternator, and this filter has proved very efficient.

The new 5,000-KW. set was named after the Mayor of Keighley (F. W. L. Butterfield, Esq., J.P.), and the opportunity was taken of giving a name to the three other turbo-alternators installed in the station, the next in size being a 2,000-KW. set, which was named after the late Mayor, Councillor W. A. Brigg, J.P., and the two 1,000-KW. sets, one after the present chairman of the Electricity Committee, Councillor Herbert Sellers, and the other after the late chairman, Councillor Henry Whitehead.

ANTHRACITE COAL.*

BY W. H. BOOTH, F.G.S.

THERE are, roughly, four general varieties of coal—lignite, bituminous, semi-bituminous, and anthracite. These are sufficiently distinct to be at once recognised as regards their average members. But there is some difficulty near the lines of demarcation, for while brown coal is at once seen to be a lignite, yet the Kaitangata coal of New Zealand, and the Bulli coal of Australia, though lignites, are very similar to bituminous coal. But Welsh smokeless coal, or semi-anthracite, has an appearance of its own, and anthracite, with its flinty looking bright fracture, its hardness and clean touch, stands very much alone.

Yet all the coals differ only in some hidden secret of their molecular make-up rather than in their bald analytical figures. Typical analyses—No. 1 of a well-known bituminous coal, No. 2 of one of the best Welsh smokeless varieties, and No. 3 of "Gwythien Goch" anthracite, as obtained from the Ammanford and Pontyberem Collieries of South Wales—are appended. Hydrogen is so often regarded as the distinguishing feature of bituminous coal, that these analyses may be a little surprising. They indicate that the influence of oxygen is of greater importance as the factor, in bituminous coal, which enables about one-third of the weight of a coal to pass away in a gaseous form when the coal is heated. Long streams of flaming gas are then set free, and if the flames are checked by contact with cold surfaces, masses of soot are deposited on those surfaces, and the flame is rendered dull and red, or is more or less completely extinguished.

With Welsh smokeless coal it is very different. Any gas in its composition comes off in short flames of easily ignited gas, which are not long enough to reach even to a nearly-placed cold surface, so that, with any reasonable care, a Welsh smokeless coal can readily be burned without showing smoke.

Real anthracite burns just as though it were pure, solid, gasless carbon. The pieces become as hot as the fire into which they are thrown, and just melt gradually away if exposed to a draught of air. There is no smoke. There is, however, a little tarry matter even in an anthracite coal, but it is very small, and only develops, as a rule, in the separator of a gas producer, from which, of course, the gas comes away not too highly heated, and leaves a little tar in the tar separator box.

Welsh anthracite is closely resembled by the anthracite of Pennsylvania, U.S.A., but the latter is harder and more splintery, and requires a keener draught to burn it. It is much used on American locomotives, because of its smokeless quality, and is burned on tubular firebars, on which it is thinly laid. He is a skilful fireman who can fire one of these large American fireboxes thinly and evenly, care being required to fill up the holes before they are fully burned through, for the American article is apt, when burned into holes, to cool rapidly round that hole, so that a blank and spreading patch of non-burning coal may form.

In order to understand the action of anthracite in the process of combustion, it is perhaps best first to describe what happens in a furnace when bituminous coal is burned and when anthracite is burned.

Taking first the case of bituminous coal, let it be assumed that a fire has burned down sufficiently to demand a further charge of coal. The whole fire is brightly incandescent, and giving off merely the short blue flames of carbonic oxide gas, which, especially if the fire is thick, will be produced when the supply of air through the grate is not sufficient completely to burn the carbon, which remains when the hydrocarbon gases have been driven off the last charge of coal. The chemical action with sufficient air is $C + O_2 = CO_2$. In this equation the nitrogen of the air is neglected as neutral. With insufficient air the action is as follows:—$2C + O_2 = 2CO$, the result being carbonic oxide gas with less than one-third the heat production of perfect combustion. Thus when fires are thick, additional air may be needed over them to burn this gas as well during the period when the hydrocarbon gases are being evolved.

The fire then being brightly incandescent, a fresh charge of coal is sprinkled evenly over its surface. The first effect is to heat the fresh fuel at the expense of the red-hot fire next the grate, and to cause it to pour out volumes of hydrocarbon gas, which bursts into flame, and demands for a short time a very considerable volume of air above the fire. This is usually admitted at the door by grids. A ton of bituminous coal will give out about 10,000 cb. ft. of gas. Assuming a charge of fresh fuel to be 56 lb. per furnace, the gas production will be 250 cb. ft. in a space of two to four minutes. To produce this amount of gas out of solid fuel will require the locking up of heat in a latent form, exactly as when any solid or liquid is vaporised. This heat can only be derived from the fuel on the grate, and since one-third the weight of bituminous coal is thus volatilised, it is clear that the fuel on the grate, now reduced by combustion to less than two-thirds its original weight, will be very sensibly cooled. The gas which has been given off will burn freely if mixed with air and not deprived of its heat of combustion by directing the flames upon too much cooling surface. The mixing with air and subsequent heating is accomplished in properly-formed furnaces by allowing the gas and air to flow together over the length of the fire and by providing an ample combustion space beyond the bridge in which complete combustion may be secured. Is it because of these suddenly produced volumes of gas, to be burned off in a fraction of the total time between stokings, that some mechanical stokers are made to give a constant feed of fresh coal at the furnace mouth, whereby a constant production of gas is secured and the working of the furnace is rendered uniform, and the supply of air above the fire is also constant; indeed, sufficient air usually gets through the thinly burned part of the fire next the bridge. Often, indeed, far too much air gets in through the nearly bare grates.

Since so much of the coal has gone away from the grate as gas, and has cooled the fire in doing so, it follows that little more than half the heat capacity of the coal is actually generated on the grate. The mean temperature of the fire is, therefore, much less than it would be if all the combustion occurred actually on the grate.

Now to take the case of anthracite, any hydrogen in its composition is apparently either free or compounded with

* Memorandum specially prepared for Mr. T. T. Pascoe, of Swansea, to whose courtesy we are indebted for the opportunity to publish it.—EDS. ELEC. REV.

carbon in such a manner that the flame is short, and is practically contained within the fuel bed. Almost all the coal is just solid carbon, which burns away completely on the grate. When air passes through the grate and comes into contact with the fuel, this is at once burned to carbon dioxide. The action is as above, $C + O_2 = CO_2$. As this gas passes up through the fire it picks up more carbon and issues at the fire surface if the fire bed is thick, as 2 CO. And this must then be burned again to 2 CO_2 by adding more air above the fire. But if the fire is thin enough, air gets through the bars to burn all to CO_2. And all the heat of combustion is thus generated near the grate surface, and it is not desirable to use grates put together so carelessly as they may be with bituminous coal. The grate bars must not present parts of their sides to the fire. Therefore, no bar should stand up above the rest, or the upstanding part risks being burned. Various methods have been adopted to prolong the life of fire-bars under anthracite fuel. Bars have been made hollow, and a stream of water run through them. Their upper surfaces have been made of trough form, and the trough has filled itself with the ash, which has insulated the bar surface from the direct touch of the hot fuel. Anthracite has been burned on flat plates in which are many holes, each surrounded with a nipple like a flat volcanic hill. The areas between these hills become filled with ash, and this preserves the metal. Some have cast very deep bars, the bellies of which have been immersed in a trough of water in the ashpit, which has kept the bars cool by conduction of the heat from the upper edge, and by the flow of steam between the bars into the fire, where the steam is split up into its constituent gases, and heat is thus abstracted from the fuel bed, and returned later on, when the oxygen and hydrogen recombine, and give up the heat taken up in decomposing them at the grate surface.

The use of steam in connection with the burning of anthracite fuel is quite general now. The anthracite is better for a little assistance to sharpen the draught, for this helps to clear the surface of the pieces of fuel from the dust left on the burning surfaces, and, by the use of steam-blown inductors, the air is forced into the ashpit, and passes with the steam directly to the furnace, where, as stated above, the steam is decomposed by the red-hot coal, and helps to moderate the intensity of the temperature at the grate surface.

By these means anthracite coal may be burned at a considerably higher rate per square foot of grate surface than if ordinary natural draught is employed, but greater care is necessary in the preservation of an even grate surface and in the maintenance of an even thickness of fire, for at higher rates of combustion the fires burn more quickly into holes, and, moreover, the thin parts of the fire are more keenly attacked by a sharp draught, and so are still more rapidly burned into holes.

THE GAS PRODUCER.

The action of anthracite when burned on a thickly-covered grate has been shown above to be imperfect in so far that the gas which results from combustion is a carbon monoxide and the heat of combustion is only 4,415 B.TH.U. per lb. of carbon as compared with 14,647 B.TH.U. for perfect oxidation.

This peculiar property is really very valuable, for by burning anthracite in a thick mass in a firebrick-lined vertical cylinder with an air inlet at the base only, the output above the fuel bed is almost wholly carbon monoxide = CO, plus, of course, the nitrogen, which goes in with the air and is neutral, and acts merely as a diluent. If now this carbon monoxide is burned with a further supply of air, it will give out 10,232 B.TH.U. for each lb. of carbon which it contains, for 14,647 − 4,415 = 10,232. The gas is thus eminently suitable for use in gas engines, and has come very largely into use for power purposes. But experience has shown that the 4,415 B.TH.U., which it is not possible to avoid producing when a gas generator is worked with dry air, are more than sufficient to carry on the proper heat reaction of a gas producer. The gas passes off very hot, and must be cooled. Thus much heat is lost. To reduce this loss, the gas, as it passes from the producer vessel, is made to heat a tank of water which forms the cover of the producer vessel, and it may also heat a vertical cylinder outside which a constant trickle of water is allowed to flow. The air to feed the producer is drawn over the wetted surfaces and over the steaming surface of the water in the cover tank, and enters the base of the producer carrying a considerable load of steam. This steam splits up, when it touches the hot fuel, into oxygen and hydrogen.

The hydrogen helps to quicken the combustion of the final gas in the engine cylinder, and the oxygen combines with the red-hot coal to form carbon monoxide. Thus it takes the place of a portion of air, and the resulting product not only now contains hydrogen, but it contains less nitrogen, and the final gas is much more powerful.

Many producers for small suction gas plants are so very small as to be little more than toys, and the grading of the anthracite to suitable size is very desirable if the gas is to be uniform in quality. Anthracite must always remain, *par excellence*, the fuel of the gas producer, for it is hard and it does not bind or cake, but moves freely down as it burns away, and fills the space of the producer evenly, avoiding empty air channels up which air would travel, and, by aiding to burn the gas above the fuel bed, would greatly reduce efficiency. There are no caves formed by the bridging across of conglomerated fuel. The pieces of anthracite are too free, loose, and dry to hold to each other, and the fuel bed is self-consolidating.

(To be concluded.)

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Simplex Weather-Proof Fitting.

A new porcelain-body watertight lantern brought out by MESSRS SIMPLEX CONDUITS, LTD., of Garrison Lane, Birmingham, is specially made up to resist corrosion and deterioration due to the weather. It consists of a heavy china body into which is cemented a metal threaded nut, to take the suspension fitting or down-drop of the conduit system.

The well glass, which is held by a metal ring with two bolts and fly nuts, completely protects the lamp and prevents corrosion of the

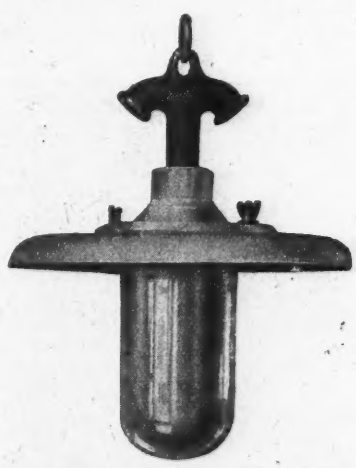

FIG. 1.—SIMPLEX WEATHER-PROOF REFLECTOR FITTING.

contacts, and keeps moisture from entering the system. The ring and the nuts are galvanised for protection. The standard well glasses are used with this fitting, so that in the event of the glass breaking, replacement is quite easily effected. The body of the lantern also has an overhanging projection which acts as a shade. It is a cheap and effective fitting, and is specially useful for garages, stables, yards, factories, and other exposed positions.

The "Depthometer."

Most firms of any magnitude have experienced the need of some method of indicating or recording the depths of liquid in distant tanks—a perfectly safe method when used in conjunction with volatile and inflammable liquids such as benzol, toluol, &c., which will indicate the depths in a continuous curve from "empty" to "full," and combine simplicity with the need for an extreme minimum of attention.

A system having these desirable advantages is obtainable in the Plummer-Burrows Depthometer, made by the FOSTER ENGINEERING CO., LTD., of Wimbledon, London, S.W.

This is an electrical device operated by an alternating current at a pressure of about 20 volts, and avoids the employment of moving contacts with consequent oxidation and unreliability. All current-carrying parts are hermetically sealed from tank vapours, the risk of explosion being thereby eliminated. Supply voltage fluctuations are corrected by means of a small automatic regulator, which smooths out irregularities in the supply pressure of 16 per cent., which variation, of course, seldom occurs in practice. There are no wearing parts in the regulator, and as accessibility has not to be provided for, the parts are sealed before leaving the factory.

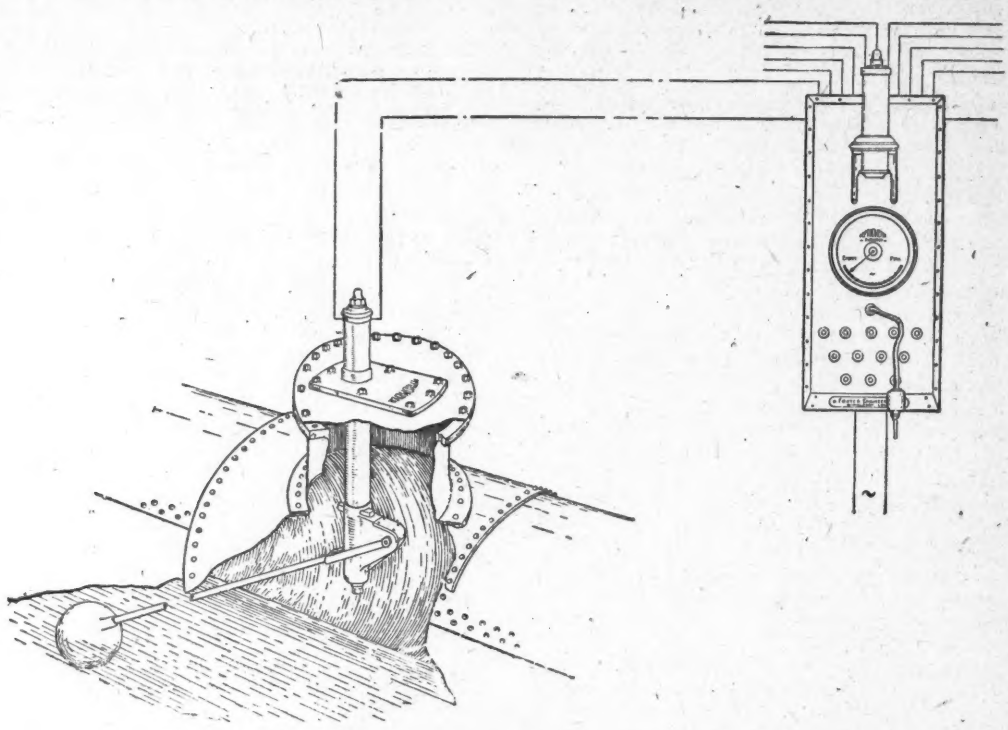

FIG. 2.—SHOWING ARRANGEMENT OF DEPTHOMETER AND RECORDING PANEL.

FIG. 3.—DEPTHOMETER RECORDING PANEL.

Fig. 2 illustrates the disposition of the various parts in a typical installation, while fig. 3 shows the panel at the recording station, on which are mounted the pressure regulator and the indicating instrument giving direct readings in feet and inches.

The float in the tank actuates the movable core of a choking coil, the coil being connected in series with a millammeter and low-pressure A.C. supply. The millammeter is calibrated at a definite supply voltage, and indicates in feet and inches.

The voltage regulator is a choking coil having two windings—an upper one connected in shunt to the supply, and a lower one, across the instrument terminals. An iron core floats in the windings, an increase in pressure tending to draw it into the upper winding, and thus to reduce the choking effect of the lower winding in parallel with the instrument, thus altering the proportion of current flowing through the latter in such a way as to compensate for the increase in total current arising from increased supply pressure.

The appliance can operate over any distance, and the current consumption is only 0·05 unit per hour.

There is only one moving part which might be subject to wear, and this, though extremely light, operates under oil, and when once installed requires no attention.

A Magneto Re-magnetiser.

A simple apparatus for the re-magnetisation of ignition magnetos has lately been brought out by the RUNBAKEN MAGNETO CO., LTD., of Campt Street Works, Deansgate, Manchester. The device is normally supplied for 100—150 and 200—250-volt circuits, but as low as 12 volts can be arranged for at a slight extra cost.

LEGAL.

ELECTRIC INSTALLATION AT A PICTURE PALACE.

MR. MUIR MACKENZIE, one of the High Courts Official Referees, on Thursday, June 7th, concluded the hearing of an action in which Mr. Joseph Mears, proprietor of the Richmond Cinematograph Theatre, claimed from Messrs. Weston & Sons, electrical engineers, damages for breach of contract in connection with the installation of electric lighting at the theatre, and for money paid under a mistake as to facts.

Mr. C. J. Conway appeared for the plaintiff, and Mr. H. J. Turrell for the defendants.

From COUNSEL'S opening statement, it appeared that by a letter dated October 1st, 1914, the defendants offered to install an electric light and power system for the plaintiff at his then newly-built cinematograph theatre at Richmond for the sum of £473. On October 9th, 1914, the plaintiff orally accepted the offer, provided that the price was reduced by the allowance of a discount of 5 per cent. It was a term of the contract that the defendants should use for the complete power and lighting installation heavy-gauge screwed conduits, enamelled inside and out, of ample size to enable the cables to be drawn in and out after erection, and that they should efficiently connect the whole conduit with the earth, and efficiently drain off any condensed moisture. It was also stipulated that there should be no joints whatever in the wiring, and that

the whole of the work should be carried out in accordance with the rules and regulations of the Institution of Electrical Engineers, the fire insurance companies concerned, the supply authorities, the Secretary of State under the Cinematograph Act, and the Surrey County Council. It was a further term of the contract that the whole of the work to be done should be guaranteed by the defendants for a period of 12 months from the date of the last certificate of completion. The breach of contract complained of was that the defendants did not use heavy-gauge screwed steel conduits of sufficient size to enable the cables to be drawn in and out after erection, and that they did not lay the conduits so that the condensed moisture could be successfully drained off. It was also alleged that the wiring was not without joints, and that the work generally was not carried out in accordance with the terms of the contract or in accordance with the rules and regulations of the authorities. The installation, it was alleged, was not, on the whole, efficient, and was not maintained for 12 months in accordance with the guarantee. By reason of these breaches of contract and warranty, the plaintiff had suffered damage, and had been put to the expense of remedying the defects, amounting in all to £109 19s. 6d. It was further stated by counsel that the plaintiff from time to time paid to the defendants sums of money on account for work performed under the contract and for extras amounting in all to £785 15s., the final payments being made on September 6th, 1915, and January 23rd, 1916, under a mistaken impression that the amounts paid were due, whereas an amount of £23 13s. was overpaid, as deduction had not been made on account of 5 per cent. discount on the sum of £473, the contract price.

In their defence, the defendants denied that the contract price was to be reduced by the allowance of discount, and they did not admit any of the allegations as to defective work. The plaintiff, they said, agreed with the defendants to appoint an architect to supervise the work and grant certificates showing, amongst other things, the completion thereof; but this they did not do. They completed the work in accordance with the terms of the contract on December 24th, 1914, and subsequently carried out their 12 months' guarantee. By not appointing an architect, the plaintiff had, said the defendants, himself committed a breach of contract, and was therefore precluded from requiring that the date of completion should be fixed by "the date of the last certificate of completion," as specified in the contract. The defendants further denied that there had been any breach of warranty.

Mr. Tom Lewin Linton, manager for plaintiff, said that after the opening of the theatre for a short time the electric lighting was satisfactory, but early in the year complaints were made that some of the lights were going wrong.

Mr. James Edgcombe, the Kingston borough electrical engineer, in the course of his evidence in support of the plaintiff's case, said that he made a thorough examination of the electric installation at the theatre, and found that while the materials used were quite good, the installation itself was defective. The method of using the materials had not, in his opinion, been in accordance with the specification. Mr. Dewhurst was called in to remedy the defects, which he did at a cost of £109 19s. 6d.

Mr. Dewhurst gave evidence as to the details of the work he had had to do to put the electric lighting of the theatre right. It having been alleged by the defence that some of the alleged defects were to be attributed to the dampness of the building, the witness, in reply to counsel, said that the theatre was a well-built structure, having cost some £3,000, and certainly could not be called damp.

Several witnesses were called for the defence to prove that the work had been properly done, that the complaints as to defects were without foundation, and that if any alleged defects did exist they were due to the dampness of the building.

Counsel for the defence argued that the onus was upon the plaintiff to show want of skill, and this he had not done, and in the result the Referee reserved judgment.

Dundalk Electric Lighting Loans.

In the Chancery Division of the Irish High Court, on Thursday of last week, Mr. Justice Barton gave judgment on the motion of the Dundalk Urban Council for a declaration (see Elec. Rev., June 8th, page 624).

Mr. Justice Barton said that the effect of acceding to the claim of the Council would be to disregard the prohibition of the statute which forbade borrowing for any purpose other than for permanent works, which expression could not include working capital, and to ignore the direction in the Provisional Order that any deficiency in income should be charged on, and payable out of, rates. He had arrived at this conclusion with regret, as he was satisfied that the Council had done everything in a *bonâ fide* and businesslike manner. It occurred to him that undertakings of this kind—municipal undertakings, in fact—were at a disadvantage in regard to working capital in comparison with commercial undertakings. He would gladly have acceded to the application if he could have done so. The action taken to obtain a declaration he held to be justified, and he hoped they would find some way out of the difficulty.

Queen Anne's Residential Mansions and Hotel, Ltd., *v.* H.M. Postmaster-General.

In the Chancery Division, before Mr. Justice Eve, last week, Mr. Maugham, K.C., moved on behalf of the plaintiff company for an injunction until judgment or further order to restrain the defendant, his servants, or agents from cutting off or disconnecting the telephone service to the plaintiffs' premises.

According to the *Times*, Mr. Austen-Cartmell, for the Postmaster-General, said that an action would not lie against a Government Department, and certainly not an action for an injunction. The Postmaster-General would, however, be prepared to waive his rights in this respect in order that the rights of the parties might be determined, on the understanding that the action should be set down for hearing at an early date.

Mr. Maugham submitted that the Post Office differed from other Government Departments in that it was carried on for profit, and was thus in the nature of a corporation. He, however, assented to the course proposed by Mr. Austen-Cartmell.

The motion accordingly stood over until the trial of the action.

Tungsten Filament Patent Litigation.

In the House of Lords on Tuesday, the 12th inst., the appeal was opened of the Osram-Robertson Lamp Works, Ltd., from a judgment of the Court of Appeal in favour of Pope's Electric Lamp Co., Ltd.

The House consisted of the Lord Chancellor (Lord Finlay), Viscount Haldane, Lords Atkinson, Parker, and Parmoor.

Counsel for the appellants, Mr. Walter, K.C., Mr. Colefax, K.C., and Mr. Gray; for the respondents, Mr. Thomas Terrell, K.C., Mr. E. M. Kerly, K.C., and Mr. E. Russell Clarke.

The proceedings at the trial of the action and in the Court of Appeal were fully reported in the Electrical Review, July to December, 1915.

In opening the appeal, Mr. Walter, K.C., said that the appellants brought an action in the Chancery Division claiming that the now respondents had infringed their Letters Patent No. 23,899 of 1904. Mr. Justice Joyce found that the respondents had not infringed the patent, and dismissed the action, with costs. That decision was upheld by the Court of Appeal, and from the Order affirming the judgment of Mr. Justice Joyce this appeal was brought.

The patent was granted to Dr. Alexander Just and Franz Hanaman for an invention of improvements relating to the manufacture of incandescent electric lamps, and Letters Patent No. 18,622 of 1906 was granted to Philip Middleton Justice for an invention of an improved method of producing metallic incandescent bodies for electric glow lamps. There was the usual claim for damages and other relief. Prior to the introduction of the appellants' process in 1904 tungsten had never been applied for use under any process for lamp filaments. No method of producing a tungsten filament was known. The appellants found that by mixing finely divided tungsten with a carbon paste material, so as to keep the metal particles together, and heating the compound in moist hydrogen, the oxygen in the water vapour combined with the carbon, and left a coherent mass of tungsten in the form of a paste that could be squirted into threads. The respondents said they employed two methods in the manufacture of their alleged infringing filaments, which were referred to in the Courts below as the "ordinary hydrogen process" and as the "vacuum process." His contention would be that they constituted differences, if they were differences at all, only from the detailed example set out in the appellants' specification. They were not differences from the essence of the appellants' invention as described in the claim, which, on its true construction, covered a process embodying all the alleged differences.

The learned Counsel went on to compare the respondents' process with that detailed in the appellants' specification and claim. He then argued the question of infringement. The hearing was adjourned.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Business Man or Engineer?

Stands Scotland where it did? Or words to that effect. Is there not one among all those who draw the breath of life from engineering to strike a blow for their mistress's fair name? Does no one challenge the insidious attack of the article in your number of May 4th on "Promotion in Electricity Supply Undertakings?" The writer calmly asserts that an accountant may become a chief engineer; that "it is generally agreed that the head of an electricity supply undertaking must be a business man first and an engineer afterwards."

In these days, electricity almost automatically sells itself. The "business" of an electricity undertaking is to produce electricity cheaply and reliably. These are both engineering problems. Given equal reliability, one unit is as good as another. Imagine a given area of supply with two undertakings having equal rights, the one run by a business man devoting most of his energy to rounding up prospective consumers, the other run by an engineer devoting most of his brain work to producing cheaply. The engineer would only want a very "dud" salesman to follow round

in his rival's footsteps and simply state that he was selling the identical thing at a farthing a unit less, and perhaps point out that, whereas the other company had had so many failures, his company had had none.

Quite recently I read in an American engineering journal of such a case, only that the "plot" hinged on the fact that one chief hesitated to scrap comparatively new engines in favour of more economical turbines. The slow man, of course, got the sack.

It seems to me that there is only one sense in which the chief of a supply undertaking must be a business man first—and that is, that he must never forget that the aim and object of all his engineering is to produce cheaply. The problems before engineers fall into two classes: Those that may be solved at "any" cost and those that have to be solved at "some" (certain maximum) cost. The power station engineer must not allow himself to be led astray into tackling problems which, when solved, are merely an engineering triumph, not a commercial success. In the past many capable engineers have done this, and so have given rise to certain false impressions and certain cheap sneers from the ignorant about "theorists." I wonder if these very "practical" gentlemen ever heard the familiar appellation of certain ancient sea-going engineers—viz., "shovel engineers" or "shovels"?

To talk about a man being a business man first and an engineer afterwards is surely putting the cart before the horse. I should like to suggest that what is popularly known as "business" is really elementary engineering, or engineering and water. Many years ago, I think at the Oxford meeting of the B.A., Mr. Balfour quoted an American definition of an engineer as "a man who can do for one dollar what any fool can do for two." That, I think, is the essence of "business." Is it too much to suggest that the Americans are such first-class business men because they are such first-class engineers? They have had engineering thrust upon them by the vastness of their country and the rapid growth of its population. Almost everything nowadays resolves itself into terms of engineering; the war, we have been told from the start, is an "engineers' war." Several years ago, at the urgent suggestion of the ELECTRICAL REVIEW (in a leader), I sent a half-crown across to New York for a copy of Mr. Salmon's Presidential Address to the American Institution of Civil Engineers, in which he asserted (very emphatically) that an engineering training was the finest business training in the world, and that more and more of the great business corporations of America were being given into the hands of engineers. Surely it would be retrograde for England (the mother of modern engineering) to adopt the policy of "business first and engineering afterwards."

I am afraid this epistle is already far too long (but I could go on for several more pages, and e'en wax violent on the subject), but it amazes me that it should be left to humble individuals like myself to take up the cudgels on such a vital subject at what is really such a vital time; for all things are in more or less of a liquid state just now. Isn't now the time when the engineer, as admittedly the most important citizen, should begin to stake out a claim for his future rights as the most highly-paid citizen? How much longer is the chief engineer going to be satisfied with half the salary of the town clerk? How much longer is he (some of him) going to try to compensate for bad engineering by the "business" subterfuge of starvation salaries to his staff? When is the I.E.E. going to make power station certificates compulsory, and bar the door to "business" chiefs?

Engineer.

News from Ruhleben.

On April 16th I received nine copies of the ELECTRICAL REVIEW, addressed to me from your office. The news that copies of the REVIEW had arrived again was greeted with great pleasure by our members, as we had almost given up hope of hearing from Ageekay in the future.

On behalf of the Technical Circle, I beg to express our sincere thanks to you, and to assure you that the 30 odd electrical men, among whom the REVIEW is circulated, keenly appreciate the opportunity thus offered them of keeping in touch with current affairs. The back numbers are constantly being referred to, and have in many instances given invaluable assistance to members preparing papers.

You will be pleased to hear that the work of the "Circle" is going on very satisfactorily, as far as possible on the lines of the Institutions at home.

In spite of the great drawback of being cut off entirely from actual practice, we are able to do a considerable amount of serious work, thanks to the increase of our technical library. Our weekly meetings show a constant increase in attendance, and we are doing our best to keep fit for the time when we can take our places in the ranks once more.

William Eric Swale,
Hon. Sec. to the Committee of the Technical Circle, Ruhleben.

Ruhleben, *April 24th*, 1917.

[We are very glad to hear again from Mr. Swale, whose letter has taken nearly seven weeks to reach us. The difficulties which caused a temporary irregularity in the supply of copies of the ELECTRICAL REVIEW were not of our making; they have now been overcome, and we hope that in future the journal will be delivered more promptly. Our cordial sympathies are with our compatriots in their enforced retirement, and we rejoice to learn that they are doing such splendid work, in spite of the disadvantages under which they labour.—EDS. ELEC. REV.]

ASSOCIATION OF CONSULTING ENGINEERS (INC.).

THE report of the Committee for the year 1916-17 states that in June last it was resolved, on Mr. Mordey's suggestion, to suggest to members that in preparing specifications and inviting tenders they should require that where possible all goods should be of British manufacture, and that where this was not possible the country of origin should be stated in the tender. The recommendation of the Local Government Board that local authorities should prepare plans and estimates for work to be put in hand at the conclusion of the war without delay is noted. The schedule of protected occupations issued on April 21st provides exemption for mechanical and electrical engineers over the age of 23, but does not mention civil engineers, whose services are often required before the former can proceed with their work, and the Committee has taken up the matter with the Ministry of Munitions. Eleven members of the Association are serving with the Forces.

The accounts show income £119, expenditure £91, leaving a surplus of £28. The assets are valued at £189. Members serving with the Forces are excused from payment of subscriptions, and the subscription for the current year has been reduced to one guinea. The members number 69.

At the annual general meeting, the CHAIRMAN (Mr. H. J. ROFE), in moving the adoption of the report, said that they had passed through another year of extreme depression for the consulting engineering profession, and there was little left for them to do but to keep their staffs together in the expectation of being called in to advise on the works which had been held over in this country during the war, and the works of reconstruction which would be necessary in the countries of our Allies on the conclusion of it.

As British capital would no doubt be largely employed in financing the schemes abroad, they trusted that British consulting engineers would to a large extent be employed to advise upon them.

The committee had continued to urge upon the Local Government Board the necessity for undertaking *now* the preliminary work on such schemes as were of urgent necessity, and which should be put in hand as soon as possible after the war. The Board had already in certain cases granted permission for the raising of loans sufficient to cover the fees and expenses incurred in preparing the necessary plans, specifications, schedules of quantities, and estimates, but he thought that the local authorities would hesitate to commit themselves to undertake the work unless the Government guaranteed their loans for such approved schemes at a fixed rate of interest.

Each year greater use was being made of the Association by individuals, local authorities, and also Government departments when requiring the services of a consulting engineer specialising in any particular branch of the profession.

Mr. SPENCER HAWES seconded the adoption of the report, and it was carried unanimously; the accounts were also adopted, and the Hon. Secretary (Mr. A. H. DYKES) announced that the following gentlemen had been elected as members of the committee:—

London Members: Mr. J. S. Alford, Mr. H. H. Humphreys, Mr. J. Swinburne, F.R.S., and Mr. G. M. Taylor.

Country Members: Mr. W. Cramp and Mr. J. E. Sayers.

Mr. F. E. Wright was re-elected as honorary solicitor, and Messrs. Cash, Stone & Co. as honorary auditors.

Votes of thanks to the chairman, the hon. treasurer (Mr. S. R. LOWCOCK), and the hon. secretary (Mr. A. H. DYKES) concluded the proceedings.

WAR ITEMS.

Summer Street Lighting.—Deptford Borough Council has received a letter from the Home Office concerning the Council's proposals for the diminution of street lighting during the summer months. The Home Secretary, after consulting the Commander-in-Chief of the Home Forces and the Commissioner of Police, expresses the opinion that where all lamps are now in lighting, one in three might be dispensed with from now until August 25th, provided that there is a lighted lamp for each 100 yards of street.

Men in Protected Trades and Tribunal Exemptions.—At Southwark Tribunal, the point was raised as to the position of men who previously had exemptions from Tribunals, but are now in possession of certificates of exemption under the Protected Trades' Schedule, as to whether they should surrender their Tribunal exemption certificates. It was held that if they were withdrawn neither the men nor their employers had a right to any further appeal at the Tribunals. —Coun. Weaver said the certificates granted the men under the schedule could be cancelled at any moment by the Recruiting Officer, and unless the men were now protected by

the Tribunal they, and their employers, would be deprived of their right to appeal. When a man was previously badged by the Ministry of Munitions and the badge was withdrawn he had the right to lodge an appeal at the Tribunal, and the same privilege should be extended to men receiving these new certificates.—The Military Representative said the latest instructions from the War Office were that in cases like this, when the men had received certificates under the schedule of the protected trades, he was not to press for the withdrawal of the Tribunal exemption certificates, and in future he should not ask for their withdrawal. That would deprive no one of the right to an appeal at any time should the new certificates be withdrawn.—The Chairman said he should not raise any objection to a man coming to the Tribunal for exemption after he had lost his certificate under the schedule. —The Tribunal decided to permit the men to retain their Tribunal certificates when granted certificates under the schedule of the protected trades.

Standardisation of Copper Tubes for Aircraft.—Difficulties having been experienced by aircraft contractors in obtaining supplies of copper tubing, the causes were investigated, and they were found to be (1) the great variety of sizes called for, (2) the fact that tube makers received orders very irregularly and for small quantities. Arising out of the investigation, the Specification Committee of the Air Board has decided that, in future, copper tube for aircraft contracts will be specified in terms of external diameter and legal Standard Wire Gauge. As far as possible tubes of 20 gauge (.036 in.) will be used, to the exclusion of all other thicknesses. Where, for special considerations, it is desirable to use other thicknesses, the choice will, as far as possible, be restricted to gauges 16, 18, and 22. The last-named is difficult to manufacture, and will be avoided as far as possible. A new Air Board specification for copper tube will shortly be issued, and will have as an appendix the following list of sizes and gauges which the Air Board regard as standard :—

20 *Gauge.*—3/16 in., ¼ in., 5/16 in., ⅜ in., 7/16 in., ½ in., ⅝ in., ¾ in., ⅞ in., 1 in., 1⅛ in., 1¼ in., 1⅜ in., 1½ in., 1⅝ in., 2 in.

18 *Gauge.*—1 in., 1¼ in., 1½ in., 1¾ in., 2 in.

16 *Gauge.*—½ in., ⅝ in., ¾ in., ⅞ in., 1 in., 1¼ in., 1½ in., 1¾ in., 2 in., 2¼ in.

22 *Gauge.*—1 in., 1⅛ in., 1¼ in., 1⅜ in., 1½ in., 1⅝ in., 2 in.

Trading with the Enemy.—The "London Gazette" for June 8th contains a number of additions to the list of persons and bodies of persons in Argentina, Paraguay, Uruguay, Brazil, Chile, Denmark, Netherlands, Netherlands East Indies, Spain, Sweden, Venezuela, and other countries, with whom trading is prohibited.

Exports to China.—A further list of those in China to whom exports may be consigned is given in the *London Gazette* for June 8th.

Controlled Works.—The number of controlled establishments is now 4,942.

Returning Municipal Employés.—Birmingham City Council has approved a resolution that soldiers, on returning to resume Corporation work, shall be offered employment, even if they are unable to resume their former positions.—*Times.*

Souchez Power Station.—In his dispatch, dated June 5th, Sir Douglas Haig said :—"We gained ground slightly during the night south of the Souchez River. The electric power station in the neighbourhood, for the possession of which fierce fighting took place on the 3rd inst., is now in our hands."

Exemption Applications.—At the Westminster Tribunal, last week, the cases of 163 employés of the London County Council tramways were considered. The Chairman asked Mr. F. W. Brock, who represented the Council, if he intended applying for the exemption of Class A men. Mr. Brock said he had to do so; all men who were not certified had gone. In respect of a man aged 28, single, Class A, he knew it was useless applying. After going through the list in six cases the Tribunal refused exemption, the other cases being those of men in certified occupations.

At Southwark, the Selwyn Electrical Engineering Co., Ltd., appeared, at the request of the Military Representative, to show cause why a certificate of conditional exemption granted the manager, 29 years of age, passed for general service, should not be withdrawn. It was stated that the firm were carrying out installations for the Southwark Borough Council, many of which were very complicated. The manager was mostly engaged on repairs at munition works, his wages being 50s. a week for 50 hours. The conditional exemption certificate was withdrawn.

At Fleetwood Tribunal, on June 8th, an electrical engineer, who had been granted six months' exemption, had his certificate reviewed. Captain Dixie said at the last hearing it was stated that the man was the only qualified electrician in Fleetwood, and on that ground he consented to exempt him. A local electrical firm, however, had written protesting against this, stating that they were qualified electrical engineers, and had received Government protection badges. Another electrical firm had written in the same strain. He had raised the matter to give public satisfaction. The respondent said there were other electrical firms, but they were not qualified electrical engineers. A qualified man was one who had served his time. The exemption was allow to remain.

Mr. John F. Cameron, tramway manager to Northampton Corporation, was recently again before the Local Tribunal on behalf of various members of the tramways staff. The following exemptions were given :—Three motormen, one month final; traffic inspector, controller fitter, carpenter, and six motormen, three months open. The chief clerk having been granted three months' exemption some time ago by the Local Tribunal, the Military lodged an objection, which they successfully sustained before the Appeals Tribunal; the chief clerk has since joined the R.G.A.

At the Lanarkshire Appeal Tribunal, the Military appealed against the continued exemption of a man, 26 years of age, employed as an electrician in a picture theatre. Major Rounsfell Brown stated that the man passed with honours in electricity at the Technical College, and he urged that his skill could be put to a better use in the Army than in a kinema house.—Temporary exemption for three months was granted, and the Military were accorded leave to appeal to the Central Tribunal.

At the Sheffield Tribunal, last week, there were the names of 149 employés of the Corporation electricity supply department to be dealt with. They represented a variety of occupations, from the engineers downwards. Mr. E. B. Gibson, of the town clerk's department, said that 183 men in the department had been either exempted or scheduled, but there were 84 men who were neither one nor the other. They could not give up voluntarily any of their 267 men, but, in fact, could do with more. In a pre-war year they produced 26½ million units, but the present output was 220 millions. Applications were now in hand for an increase of 40,000 H.P., and there was also another scheme on hand. The department did not wish to retain the young single men, but if they lost any of those men efficient substitutes must be forthcoming. In view of negotiations in regard to substitution, the Tribunal agreed to the adjournment of all the cases for 14 days on the understanding that appeals could be made in all cases not covered by certificates or exemptions, or in which any hitch might occur.—*Sheffield Independent.*

Renewed exemption for four motormen was sought at Brighton by Mr. Marsh, manager of the Corporation tramways, and also for a timekeeper. One of the motormen, in Class C 2, was given a final month, and the others were each allowed until October 27th.

A review was made at Oxford of the cases of F. Chatwin (34), fitter, and H. Holmes (29), chief engineer, both with the Electric Tramways Co., and both passed for general service. It was intimated that the latter was leaving for the Army at once, and was applying for a commission, a substitute over military age having been secured. Chatwin, it was stated, was the only fitter the company had for day work, and they had no one to replace him, substitutes sent having been men of no experience. The Tribunal granted Chatwin a month's temporary exemption, with a view to substitution.

Conditional exemption, granted on May 29th, 1916, to C. Howard (34), electric fitter and wireman with Messrs. Hill, Upton & Co., electrical engineers, Oxford, was reviewed. The firm produced a certificate showing that Howard was in a reserved occupation, and was not liable for military service until he had had his calling-up notice. The Tribunal withdrew the certificate, as Howard is in the hands of the dilution authorities.

At Oxford, renewed exemption was sought by H. G. Watson (29), electrical engineer and fitter, of Turl Street. He stated that 11 years ago he took over his late father's business; he did all the managing and the electrical part of it, was electrician to eight colleges, at some of which cadets were billeted, and was also engaged on Government work in the city, and had a direct contract with the Admiralty. The appeal was respited for appellant to communicate with the dilution officer.

The Military appealed to the County Tribunal against temporary exemption to September 1st held by R. Lerwill (18, in Class B 2), charge engineer with the Ilfracombe Electric Light Co. Lieutenant Stirling pointed out that the company had two engineers to work two shifts, which covered 18 hours, and he asked what prevented the manager from taking the place of one of the engineers, who would then be released for service. The manager replied that his duties as manager would prevent him from doing as Lieutenant Stirling suggested. If he took over one of the shifts, say the night shift, and the cables went wrong, he would not be able to leave the works, and the town would be plunged into darkness. The appeal was disallowed, and the exemption confirmed.

On a military appeal, the Southend-on-Sea Tribunal has withdrawn the exemption certificate held by a switchboard attendant (28), engaged at the Corporation electricity works. A tram-driver (36), for 13 years with the Corporation, was given final exemption until August 1st.

At Colchester, the Tribunal appealed against exemption held by a stoker at the Corporation electricity works. The electrical engineer said that the stoker was also exempted under a protection certificate. Lieutenant Payne ascertained that others possessing such certificates included the switchboard attendant, aged 20, unmarried, and passed for general service, and said that he thought it was scandalous that these certificates should be given, and he would bring the matter before the proper authority; this would probably be the

means of their losing their protection. The appeal was assented to.

At Carlisle, Messrs. Morton applied for exemption for Mr. A. Munro (22, in Class B 1), assistant electrician, and stated that they had 70 electrical machines, and owing to shortage of skilled labour they had to do their own new wiring, repairs, and installation of electrical power. Conditional exemption was granted.

The Corporation applied at Carlisle for exemption for W. Lindsay (18), apprentice in the electricity department. The town clerk said that Lindsay, who had rupture, was not fit for Class A, in which he was placed. It was decided that he should go before the Central Medical Board if he could not get a position as mechanic in the Flying Corps.

Before the Cornwall Appeal Court, the Military appealed against conditional exemption allowed to H. Jenkins (39, in Class B 1), electrician and electrical fitter with the Hotel Victoria, Ltd., of Newquay. He was directed to report for service on June 30th.

At Bexley, an appeal for W. H. Charley (30, in Class C 3), armature winder, with Dickinson's Electrical Manufacturing Co., Ltd., was respited until he is called up. The same Tribunal withdrew conditional exemption held by six motormen on the U.D.C. tramways, and exempted them until efficient substitutes are obtained.

An appeal at Bedford by the Igranic Electric Co., for the retention of F. Morris (41), a time-expired man, was adjourned until he is called up.

The Military appealed to the Northants Tribunal against exemption held by Mr. F. L. Perrin, electrician, Northampton. Respondent, who was one day short of the age which placed him in a certified occupation, said that he was constantly engaged on electrical work at factories in the town and district, and in the winter worked almost night and day, and on Sundays. The appeal was disallowed, and the exemption confirmed.

BUSINESS NOTES.

Italy.—A new company has lately been formed in Turin, with a capital of £800,000, and the title La Società del Alluminio Italiano, to carry on the manufacture of aluminium and other electrochemical products, to establish hydro-electric power plants, &c., in Italy. The Società Idroelettrica di Villanueva e Burgofranco, the Société des Tréfileries du Havre, and the Società Trafileri e Laminatoi di Metalli are interested in the new undertaking.

Patents and Alien Enemies.—A licence has been granted to the United Flexible Metallic Tubing Co., Ltd., to use Patent No. 3,822/09, granted to Witzenmann.

Bankruptcy Proceedings.—GEORGE A. SMITH, 61, Pall Mall, and GEORGE A. SMITH & Co., 61A, Pall Mall, S.W., consulting engineers.—The first meeting of creditors was held on June 8th, at the London Bankruptcy Court, the proceedings having been consolidated by order of the Court on May 17th. Mr. J. B. Knight, Official Receiver, reported that the debtor had stated that prior to 1914 he was in business as a consulting engineer. Six months before the outbreak of war, with the object of carrying out hydro-electrical enterprises, he promoted the Pall Mall Development Corporation, Ltd., of which he was appointed managing director. That company never did any business, and the debtor returned his loss over it at £400. Later he promoted other companies. Two years ago the debtor patented an indicator buoy for drifter patrol; it had been taken over by the Government, and the debtor was now attached to the Admiralty as an electrical engineer. He claimed that he had no personal debts of any kind, and that he was perfectly solvent, his present position being due to his having financed the Swindon Engineering Works, Ltd., and to his having made himself liable for the debts of that company. Proofs to the amount of £1,760 were dealt with by the chairman, and a resolution was passed for Mr. E. H. Hawkins, chartered accountant, 4, Charterhouse Square, E.C., to act as trustee, and administer the estate in bankruptcy. The chairman declined to adjourn the meeting, but intimated that notice would be given to the debtor of the application for the adjudication order, and he could then place the position before the Registrar.

Canadian Exhibition. — The thirty-ninth Canadian National Exhibition is to take place in Toronto, from August 25th to September 10th, 1917, and an attendance of a million visitors is looked for. Exhibits relating to agriculture will be important, including a large display of tractors, and there will be farming and other like demonstrations and competitions. British firms who may be desiring to take space should apply at once to Dr. J. O. Orr, general manager of the Exhibition, 36, King Street East, Toronto. There will be a Machinery Hall and Electrical Building. Fuller particulars will be found in last week's *Board of Trade Journal*.

Mr. Dudley Docker and the Electrical Industry.—In the course of his recent speech as chairman of the Metropolitan Carriage, Wagon, and Finance Co., Ltd., Mr. F. Dudley Docker referred to the steady growth in the membership of the Federation of British Industries, alluded in unmistakeable terms to the hostility which had been displayed in Parliament to the British Trade Corporation, and finally devoted his attention to the British electrical industry. He said that in the judgment of the board of the Metropolitan Co. the electrical industry had remained too long in foreign hands. "There is no doubt that the work of electrical construction will play an essential part in British trade development, and, continuing the policy your directors have always pursued, anticipating rather than following, we have acquired a controlling interest in the British Westinghouse Co. It is a considerable event in itself, and we may perhaps be pardoned if we are somewhat proud that this control should be in British hands, and more particularly in ours. We may not stop here. Chapter 3 is only beginning. . . . . Your board and your staff . . . are alive to the tremendous call the future will make upon their energies as well as their abilities."

Trade Announcements.—THE NEW SWITCHGEAR CONSTRUCTION CO., LTD., of Sutton, Surrey, announce the following appointments :—

Messrs. Plunket & Abbott, of Lynwood, Llanishen, Cardiff, as their representatives in South Wales district, including Glamorgan and Monmouth.

Mr. R. H. Willis, M.I.E.E., of 211, Produce Exchange, Cathedral Street, Manchester, as representative in Manchester district.

MESSRS. WOOLFALL & RIMMER, of 71, London Street, Southport, have purchased the business of Messrs. John Boyd & Son, electricians, Hoghton Street and Chapel Street, and will conduct it in future.

Book Notices.—"Electrical Engineering Practice." By J. W. Meares. London: E. & F. N. Spon. 25s. net.

"Year Book of Wireless Telegraphy and Telephony for 1917." London: The Wireless Press. Price 3s. 6d. net.

"Industrial Fatigue in its Relation to Maximum Output." By H. J. Spooner. London: Co-Partnership Publishers. Price 6d.

Practical Dynamo and Motor Management. London: S. Rentell and Co., Ltd. Price 6d. net.—While the text in this new edition shows little alteration, a considerable number of new illustrations has been introduced; these include a useful set of clear diagrams of connections for D.C. motors and generators of various types, which should prove useful.

The June issue of the *Faraday House Journal* contains a portrait of Dr. Alex. Russell, obituary notices of old Faradians killed in action, abstracts of papers by Mr. L. Kettle and Mr. S. E. T. Ewing, and supplementary lists of past and present students and members of the staff who are serving with the Forces.

Liquidations. — STEEL'S ELECTRIC & ENGINEERING CO., LTD.—A petition for winding up this company has been presented to the Courts by C. S. Milne & Co., Ltd., of Millwall, judgment creditors, and is to be heard on June 19th.

BRITISH GRAETZIN LIGHT, LTD.—The Controller, Mr. Thos. Wise, has applied for his release.

COLSTON ELECTRICAL WORKS, LTD., Bristol.—June 22nd is the last day for receipt of proofs for dividend by the liquidator, Mr. C. H. King, 26, Balwin Street, Bristol.

British Manufactures in Australasia.—*New Zealand Shipping and Commerce* for April 19th publishes an appeal from Mr. R. H. Butler, the secretary of the B.E.A.M.A. in Australia, urging prospective customers to abstain, wherever possible, from placing their orders with non-British manufacturers. They are asked to do their utmost to wait until manufacturing conditions more favourable to export are brought about in Great Britain.

France.—A new company has lately been formed in Paris (15, Avenue Matignon), with a capital of £24,000, and the title La Compagnie des Chemins de Fer Electriques du Jura.

Patent Restoration.—An order has been made restoring Patent No. 4,401 of 1911, granted to Max Weertz, for "Improvements in apparatus for artificially producing daylight for colour-matching purposes."

LIGHTING AND POWER NOTES.

Bangor.—YEAR'S WORKING.—There is a deficiency of £1,096 on the working of the electricity undertaking for the past year, as compared with £463 for the previous year. Owing to lighting restrictions, the revenue from lighting had decreased from £3,611 to £3,164.

Belfast.—In connection with the strike of labourers at the Corporation generating station, the men have returned to work, on the understanding that their claims would be dealt with during the week.

B. of T. Committee and Municipal Electricity Suppliers.—This week's addition to the numerous municipal authorities who have passed resolutions urging that greater representation shall be given on the B. of T. Committee on Electricity Supply includes Stoke-on-Trent, Burnley, St. Anne's, Morley, Aberdeen, and Carlisle. At a meeting of the Parliamentary Bills Committee of the Convention of Burghs, Councillor Stevenson, of Edinburgh, was appointed as its representative to give evidence before the above Committee.

Bolton.—Councillor Jackson recently drew attention to the fact that the Electricity Committee's gross profit had increased by £8,378 on the previous year, although the average price per unit

had gone down from 1·05d. to 0·96d. The average cost of fuel had fallen from 0·316d. per unit to 0·243d., showing that the Committee was right in its policy of encouraging consumption by giving cheap rates to large consumers.

Bootle.—PLANT SHORTAGE.—Owing to the lack of sufficient plant, the Electricity Committee has been compelled to refuse new business, which would have required three times as much electricity as is used by the tramways, and would have brought in a revenue of about £9,000 a year.

Bradford.—WAGES.—Representatives of the Corporation workers are demanding a 65 per cent. increase on pre-war rates of wages; the Corporation War Wages Sub-Committee has decided to revise the existing wages scale, so that men will obtain 12s. per week increase on pre-war rates and women from 4s. to 6s. per week. Various concessions are being made in regard to overtime and Sunday pay.

Cheltenham.—PRICE INCREASE.—The T.C. has decided, in view of the fact that the B. of T. arbitrator has granted an increase of 6s. 6d. in the wages of most of the employés in the electricity department, to raise the price of electricity 10 per cent. all round to consumers.—*Birmingham Post.*

Clayton.—E.L. PROPOSALS.—At the D.C. meeting, last week, a motion to rescind the agreement with the Yorkshire Electrical Distribution, Ltd., and to withdraw the Council's support from its application for a provisional order, was postponed for a fuller meeting of the Council. During the discussion it was pointed out that the D.C. was not in possession of Bradford's terms of recent date, and to throw over the company before knowing these would decrease the Council's bargaining power. It was also pointed out that if the motion was defeated, it could not be brought up for a further three months.

Continental. — FRANCE. — A considerable impulse is noticeable throughout France in electrical undertakings, in strong contrast to the period before the war. As a matter of fact, the number of these in 1884 was only eight. In 1914 the number had increased to 1,175, some of them with plant capacities of 10,000 H.P. The utilisation of the great hydraulic resources of the Alps region supplies energy to 10 departments, with an area of 57,000 sq. km. The waters of the Isère, the Arve, and the Durance furnish supplies which are utilised by 12 hydro-metallurgical companies with a total of 180,500 H.P. In 1914, numerous schemes were investigated for the establishment of new undertakings. As electrometallurgy has rapidly developed during the war, the greater number of these schemes have been realised, or are on the road to realisation. The Société de l'Electricité du Centre, which distributes electric current to the cities and factories of the Loire, Upper Savoy, and the Allier, disposes of 20,000 H.P. Before 1914, the manufactories in the South-East were only scantily furnished with power. One of the most marked results of the war is, however, the stimulation of industrial movement in the Lanquedoc, Gascony, and Guyonne districts, which has resulted in further electrical development. The Société de l'Energie Electrique of the Pyrenees has greatly increased its industrial *clientèle* in the course of the war. Its network is now more than 1,100 km. in extent, and its resources total over 50,000 H.P., supplied from the waterfalls, lakes, and rivers of the Pyrenees.

SPAIN.—In our issue of April 13th (page 405), we quoted some interesting statistics relating to the progress of the Spanish hydro-electric industry in 1917, which, we now learn, were first published in our valued contemporary *La Energia Electrica*. We regret that the source of the information was not indicated in the note.

Derby.—PROPOSED LOANS.—The Electricity Committee has decided to apply for loans of £2,000 for mains, £4,000 for motors, and £7,500 for the extension of the power station in excess of the estimates.

Dewsbury.—PRICE INCREASE.—The Electricity Committee has decided to increase, from July 1st, the scale of charges to consumers as follows:—10 per cent. on the power and heating rates, 2½ per cent. on the lighting rate, and 2½ per cent. on the rateable value rate per unit.

WAGES.—The T.C. has decided to make wage advances or bonuses granted since the outbreak of the war up to 10s. per week, exclusive of scale advances.

Gloucester.—PRICE INCREASE.—The T.C. has decided to increase the charges for current for lighting and power by 13⅓ per cent., as from the end of the June quarter, this making an advance of 33⅓ per cent. since the war broke out.

YEAR'S WORKING.—The accounts of the Corporation electricity undertaking for the year ended March 31st last show a total revenue of £16,972, being, as compared with 1914-15 (the last year to show a profit), an increase of £1,411. The total works cost was £11,972, an increase of £4,432, as compared with 1914-15; coal, wages and rates accounted for an increase of £4,795 in the expenditure. The gross profit was £5,000, interest on loans and repayment of capital totalled £7,847, the net deficiency on the year's working being £2,847.

Halifax.—The Council in Committee considered proposals of the Electricity Committee for the purchase of land between the River Calder and the canal near Sterne Bridge, Copley, as a site for a new electricity station; the resolution was lost by one vote, and it was decided that the question be adjourned to a special meeting of the Council, to be held at an early date.

Harrogate.—The T.C. is to be asked to sanction an increase in the proposed loan application, from £3,000 to £4,710, for the installation of a by-product steam-boiler plant.

Lincoln.—YEAR'S WORKING.—The annual report of the Corporation electricity undertaking for the year ended March 31st shows that the total revenue amounted to £27,325, an increase of £9,877; working expenses were £18,785, an increase of £8,268, due to increased cost of coal, wages, and materials. The gross profit was £8,492, an increase of £1,588, and the net profit £3,129, as compared with £1,690 for 1915-16, an increase of £1,439. The output of electricity for the year was 5,345,000 units, an increase of 69 per cent., the increase having been obtained without in any way increasing the capacity of the generating plant.

London.—BATTERSEA.—The Electricity Committee having considered applications for an increase in the supply of electricity in the neighbourhood of Wellington Road, Battersea Bridge Road, and Nine Elms, recommends that the necessary extensions be carried out, at a cost of £1,441.

The Baths Committee recommends that the electric wiring at the Nine Elms Swimming Baths be replaced, and half-watt lamps substituted for the existing lamps, at a cost of £96.

In Belgrave Road, Pimlico, last week, 450 ft. of the pavement and 13 of the distribution-boxes of the Westminster Electric Supply Corporation were suddenly blown up, the force of the explosion wrecking many windows in the locality.

HACKNEY.—The Finance Committee recommends the Council to amend its application to the L.C.C. for sanction to the advance of £6,500 in connection with the linking-up scheme with the North Metropolitan Electric Power Co., substituting £3,500, as the Council has no authority to borrow money in respect of expenditure upon work of this purpose outside the Council's area.

The Finance Committee recommends that it be authorised to take up from the L.C.C. a loan of £6,500, repayable in 30 years, and £3,185, repayable within three years, at the rate of 5½ per cent., for extension of the electricity buildings.

The Electricity Committee recommends that a subscription of £3 3s. be made to the I.M.E.A. towards the current expenditure of the research into the heating of underground cables, conducted by the Research Committee of the I.E.E.

Loughborough. — PRICE INCREASE. — The T.C. has advanced the price of current supplied to cinemas from ½d. to 2½d. and for factory lighting from 3d. to 4d. per unit; existing consumers are to be charged a minimum of 5s. per quarter, and those becoming consumers after October 1st £2 a year.

Luton.—PROPOSED LOAN.—Application is to be made to the L.G.B. for sanction to the borrowing of £3,660 for laying additional mains to works in the town.

Middleton.—The T.C. having been refused sanction to the borrowing of £5,110 in connection with the supply to Neva Mills, has decided to lay the case before the Manchester authorities, who have carried out the work for the Council, with a view to their loaning the money.

Morley.—YEAR'S WORKING.—The total revenue of the electricity department for the past year amounted to £3,909, and the total expenditure to £2,863, leaving a gross profit of £1,046. After making provision for interest and sinking fund, however, there was a net deficit of £1,054, against a deficit of £612 for the previous year.

Newcastle (Co. Down). — STREET LIGHTING.—The Electric Lighting Co. has offered to renew the street lighting contract, for the ensuing three years, at £240 per annum—an increase of £40.

Oldham.—Ald. Hardman, chairman of the Corporation Electricity Committee, at the monthly meeting, said the profits of the department during the past 12 months were £9,032, as against £5,100 in the previous year, and this result had been obtained despite many drawbacks. The falling off in the lighting revenue was £2,200, as compared with the previous year. They sold 14½ million units, as compared with 10 million, whilst in 1913 they sold only 6½ million. The revenue had risen from £46,500 to £72,500 in four years, though the average price had been reduced from 1·703d. per unit to 1·201d.; they had reduced their coal consumption per unit by one-half, and though coal cost them 1s. 9d. a ton more, they used 550 tons less.

Rochdale.—The Corporation has approved a new arrangement with the D.R. Cotton Mills, Ltd., for an increased supply of electricity. Instead of a maximum demand of 1,350 KW., the Corporation is to supply from 1,850 to 2,000 KW. normally, the company to pay an extra £2 per KW. in respect of every KW. over 1,350, this £2 being the new scale. Should the company require more than 5,000,000 units, the quantity provided for by the agreement, the excess is to be paid for at the same price per unit as other consumers, according to the new scale. It is hoped the arrangement will prove mutually satisfactory.

St. Helens.—The income of the electricity department for the year ended March 31st last, amounted to £40,657, and the expenditure to £41,159, leaving a debit balance of £502. There had been an increase in the income of £6,600, and in the expenditure of £7,400, of which £4,600 was for fuel and £1,000 income-tax.

Sheffield.—PROV. ORDER.—The Electric Supply Committee proposes that application be made to the B. of T. for a prov.

order to supply electricity in the rural district of Wortley and other districts surrounding Sheffield.

The Health Committee is asking the Electric Supply Committee to provide a reserve supply of electricity, with the necessary equipment, for the Lumley Street destructor, at an estimated cost of £830.

Sunderland.—Year's Working.—The report of the Corporation electricity undertaking for the year ended March last shows a total revenue of £78,200, made up as follows:—Private lighting and heating, £17,732; power, £41,701; tramways, £12,272; and public lighting, £2,479; working expenses totalled £45,502, and after meeting special expenditure, a gross profit of £29,469 remained. Interest on loans and sinking fund charges absorbed £31,491, leaving a debit balance of £2,025, which it was proposed to take from the rates. The report states that, following the stagnation in the shipbuilding industry in 1909 and 1910, efforts were made to increase the output and reduce the working expenses, with the result that by 1914 the credit balance had reached £9,011. Had the conditions then prevailing remained approximately constant, annual surpluses would have followed. The breakdown of a large turbine involved a loss of £3,500 for the 33 weeks it was idle. A Committee had been formed having within its area the principal electrical undertakings on the North-East coast, and on behalf of the Newcastle Electric Supply Co. a verbal proposal had been made to Mr. Blackman, of the Sunderland Corporation, as to a reciprocal supply between Newcastle and Sunderland.

Sutton (Surrey).—Street Lighting.—The Electricity Co. has made a further reduction in the charges for public lighting on account of the non-use of lamps, it having charged one-third of the contract price instead of one-half.

Swansea.—Year's Working.—At last week's meeting of the Electric Lighting and Tramways Committee it was reported that the working of the electricity undertaking for the year ended March 31st last, showed a gross profit of £18,357, as against £18,104 in the previous year. The total income was £39,015, as against £38,294, and the working expenses amounted to £20,658, as against £20,194. The loan charges, &c., amounted to £14,005, as compared with £13,215, for the previous year, and the net surplus was £4,412, as against £4,944 for 1915-16. After debiting special expenses, totalling £1,198, there remained a balance of £3,214, which had been placed to reserve, the reserve fund now standing at £14,065. The borough treasurer said that with regard to excess profits duty, he had succeeded in claiming exemption on the ground that the majority of the Corporation undertakings were unremunerative, and, therefore, the Corporation made no profits. In the tramways section the surplus for the year was £1,383, as against £1,557 in the previous year.

Tonbridge.—The D.C. has decided to carry out extensions at the electricity works, at a cost of £17,000, to supply local factories.

U.S.A.—On April 30th, the City Council of Los Angeles passed a resolution approving of an agreement for the purchase of the distributing systems of the Southern California Edison Co. and the Pacific Light and Power Corporation, in Los Angeles, and of a contract for supply to the city by the companies for a period of 30 years. The purchase price is £1,694,000, in addition to which there are certain extras. The minimum supply to the city is to be 25,000 H.P., at an annual load factor of at least 36 per cent., for 10 years. The city has also recently inaugurated a hydro-electric plant of 22,500 KW. for its own use. Before the agreement abovementioned can be executed, the charter of the city must be amended, with the approval of the State Legislature, which, however, has recently adjourned, and will not sit again till January 1st, 1919. To meet the difficulty, a temporary agreement has been made whereby the companies' systems are to be operated by them on behalf of the city until the permanent agreement can be brought into force; the companies are also distributing the power generated by the new municipal plant. But a third power company, the Los Angeles Gas and and Electric Corporation, which was not a party to the arrangement, has challenged the legality of the proceedings, on the ground that the contract violates the charter of the city, and has filed an action in the Superior Court with a view to restraining the city from continuing the operation of the temporary agreement.—*Electrical World.*

Wolverhampton.—New Plant.—In consequence of the urgent demand for more power, and with the support of the controlling authority, a scheme for installing three additional Stirling boilers, which were being completed for another purpose, has been prepared. The estimated cost of this plant, with stokers and draught plant, is £24,687, as against £18,457, the estimate for the original two-boiler scheme which had been adopted, and it is proposed that the Corporation shall pay a portion only of the extra cost.

Worcester.—Year's Working.—With further reference to our previous note, the total income of the electricity department for the year ended March 31st last was £25,178, compared with £21,225 for 1915-16, being an increase of £3,953. Generating and distributing costs totalled £13,576, leaving a gross profit of £11,602, which is equal to 14 per cent. on the capital outstanding. After payment of interest, sinking fund charges, and income-tax, there was a profit of £812. An output of 757,895 units was generated by the water plant at Powick, compared with 607,682 units in the previous year. During the year 3,487,561 units were sold, as compared with 2,557,104 units in 1915-16; lighting units decreased by 33,038, while power and heating units increased by 1,023,505. The cost of production, in spite of adverse conditions, was reduced to ·86d. per unit sold, as compared with ·89d. per unit in the previous year.

TRAMWAY and RAILWAY NOTES.

Blackburn.—The T.C. has decided, by 37 votes to 8, that the tramway service between Witton Stocks and Cherry Tree shall be closed down, in order that the rails may be taken up and utilised in repairing other sections.

Bournemouth.—The profits for the past year of the Corporation tramway undertaking totalled £16,275, being £1,218 more than estimated. The Council has decided, on the recommendation of the Tramways Committee, that no advantage would be obtained through the employment of women conductors.

Continental.—Spain.—A scheme for the construction of an electric tramway to connect the towns of La Corunna and Santiago is again under consideration.

Dewsbury.—Increased Fares.—Tramway fares between Dewsbury and Ossett and on neighbouring lines have recently been advanced.

Eccles.—Subject to the consent of the authorities, the T.C. has decided to lease the tramways in the borough for 35 years to the Salford T.C., who will pay a rent of £6,677 per year, being 10 per cent. on £66,767, the capital cost.

Irish Electric Railways and B. of T.—It is announced that the B. of T. now propose to take control of the Dublin and Lucan, and Dublin and Blessington Railways, as in the case of the other railways in the country. A strong agitation has been carried on with this object in view recently.

Glasgow.—Lottery Tickets.—Notwithstanding the protest of the Crown authorities, the Corporation tramway prize-drawing scheme has been continued, but on Saturday it was stated that unless the draw, which is legally regarded as a lottery, was stopped, legal proceedings would be taken against the Corporation and certain officials. A Conference on Saturday of the members and officials concerned decided to ask the Tramway Committee to consider the whole question. The tramway manager decided to withhold prizes after next week, but to continue the sale of tickets.—*Daily Telegraph.*

Lancaster.—Year's Working.—Actual figures now available show that the Corporation Electric Tramways, hitherto a heavy drain on the rates, have finished the past year with a deficit of only £65, as compared with the previous year's deficit of £1,512. The revenue has increased by £1,975, whilst the expenditure has decreased by £184, notwithstanding the payment of £200 to families of men on military service and nearly £100 in war bonus. A good deal of credit is given to the electric 'buses under the department.

Lancs. and Yorks. Railway.—On Tuesday, last week, on the electric portion of the L. & Y. Railway Co. between Manchester and Bury, a goods train and a billet train came into collision, three men being injured and the traffic disorganised for 12 hours.

Leeds.—The Corporation Tramways Committee is considering a suggested scheme for conveying coal on the tramways to the city hospitals.

Manchester.—Rate Relief.—The economists won the day at the adjourned meeting of the City Council last week. Owing to the decreased estimates of profits from the trading concerns, it had been expected that an increase of $4\frac{1}{10}$d. in the rates would be necessary, but the Council, by deciding to make further calls upon the gas, tramway and electricity undertakings, were able to reduce the increase to a fraction under 1d. in the £. The Electricity Committee had only proposed giving £16,570 to the rates, and this the Council approved by a majority of three votes only. Councillor Sutton said if the amendment to give £30,000 was carried, it would mean an increase in the price of electricity, which would handicap an important department, and Councillor Jackson said the system of getting these profits from the trading departments was a vicious one. The Tramways Committee was not so fortunate, however; it had proposed to hand over £50,000, as against £100,000 last year, and although it was pointed out that the demand for increased wages made by the employés would, if granted, absorb £90,000 a year, the Council, by 48 votes to 45, decided that the Committee should contribute the same amount as last year. To the suggestion that this would mean increased fares, the reply was made that Manchester's position was ridiculous, as there was no other town where tramway fares were so low.

Middlesex.—Fares.—The C.C. has sanctioned an increase in the fares of the M.E.T. Co., based on the principle of three consecutive stages for a 1d. Workmen's fares are to be half those for ordinary passengers, with a minimum of 1d. and maximum of 4d.

Newport.—Tramway Extension.—An inquiry was held recently by the Light Railway Commissioners into the proposal of the Corporation to extend the tramway from Pill terminus to the Alexandra Dock Gates, at a cost of £15,500. It was stated at the inquiry that the Commissioners were prepared to sanction the scheme.—*S.W. Weekly News.*

Sheffield.—YEAR'S WORKING.—The annual report of the Corporation tramways department, issued this week, shows that up to March 25th the total capital expenditure had been £1,092,146. The income on revenue account for the year was £525,685, and the total working expenditure £335,765, giving an average cost of 8·340d. per car-mile, compared with 7·333d. in the previous year. In addition to the ordinary expenditure, £11,848 had been paid out in allowances to dependents of employés, leaving a gross profit on the year's working of £178,070. After making allowances for interest on mortgages, sinking fund, income-tax on profits, and other charges, there remained a balance on the year of £88,478, a decrease of £7,301 compared with the previous year. This balance will be appropriated as follows:—Street improvements, £8,381; renewals fund, £34,698; accumulated surplus fund, £1,179; special purposes fund, £2,000; and to special items of capital expenditure, £1,174; leaving a sum of £40,097 to be transferred to the general district rate and to the Development Committee. In the motor-omnibus section the traffic revenue was £34,407, and with other items the total income was £34,966. The working expenses totalled £25,432, and £443 had been paid out in allowances to dependents, and £3,159 set aside for depreciation of omnibuses. The gross profits were £5,932, and after allowances for sinking fund, &c., there remained a net balance of £3,807.

Walsall.—YEAR'S WORKING.—For the 15 months ending March 31st, 1917, the net profit on the tramways was £11,963, and on the motor-omnibuses £3,146. Out of the total £5,000 is to be placed in relief of the rates and £1,800 to be placed against the cost of obtaining the Walsall Corporation Act, 1914.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—August 22nd. N.S.W. Government Railways and Tramways. Thirty-six induction motors (Specification No. 488). September 19th.—One 225-H.P. synchronous motor (Specification No. 489). Particulars from Electrical Engineer's Office, 61, Hunter Street, Sydney.

MELBOURNE.—July 25th. Victorian Railways. Step-down transformer and sub-station equipment for Sandringham-Black Rock electric tramway. Particulars from the Chief Storekeeper, Railway Offices, Spencer Street, Melbourne.

Erith.—June 23rd. Electricity and Tramways Department. One water tube boiler with superheater economiser, automatic stoker, &c. See "Official Notices" to-day.

Glasgow.—Electricity Department. Boiler house plant. E.H.T. switchgear (20,000 volts). See "Official Notices" to-day.

Newport (Mon.).—June 30th. Electricity Department. Induced draught plant, additions and extensions to fuel economisers and cooling towers. See "Official Notices" to-day.

Spain.—The municipal authorities of Ecija (Province of Seville) have lately invited tenders for the concession for the electric lighting of the town during an unnamed period. Tenders have also been recently invited by the municipal authorities of Guadalajara for the concession for the electric lighting of the town during a period of ten years.

Wolverhampton.—June 22nd. Reinforced concrete coal-bunkers and skeleton structure, for the Electricity Department. Mr. S. T. Allen, Engineer and Manager.

June 30th. Electricity Department. Cooling towers, motor-driven pumps. See "Official Notices" to-day.

CLOSED.

Sheffield.—T.C. A. Reyrolle & Co., Ltd.: 25 transformer protection sets.

Stretford.—U.D.C. Veritys, Ltd.: two 15-H.P. motors, at £92 15s. each.

Wolverhampton.—T.C. Accepted tenders:—

H. Gough & Son.—Building work in engine room, £1,301.
Gibbons Bros., Ltd.—Steelwork to extend roof of engine room, £350.
Willans & Robinson, Ltd.—Turbo-alternator set, condensing plant, &c., £22,600.
Higgs Bros.—Three 10-H.P. and one 5-H.P. motors, £180.
Stirling Boiler Co.—Boiler plant, £24,687.

Steel Works on the Tees.—According to the *Times*, the Tees Conservancy Commissioners last week transferred 21 acres of river frontage at Stockton-on-Tees to the East Coast Steel Corporation, who need the frontage for the erection of works which will cost three million sterling.

FORTHCOMING EVENTS.

Institution of Mining Engineers.—Friday, June 15th. At 11 a.m. At Burlington House, Piccadilly. General meeting.

Incorporated Municipal Electrical Association.—Thursday, June 21st. At 10 a.m. At the Institution of Civil Engineers, Great George Street, Westminster, S.W. Annual meeting. Presidential address by Mr. F. M. Long; papers on "Individual Interests in Municipal Enterprise," by Mr. J. H. Bowden; and "Fuel Economy," by Mr. J. A. Robertson.

Friday, June 22nd, at 10 a.m., Council meeting. At 10.30 a.m., annual general meeting.

Tramways and Light Railways Association.—Friday, June 29th. At 3 p.m. At Institution of Civil Engineers. Annual congress.

OUR HALF-YEARLY INDEX.

As it is necessary to effect every possible economy in paper consumption, the Index to Vol. 80 of the ELECTRICAL REVIEW, which will be printed in the course of a few weeks, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d. post free. Any reader or advertiser at Home or Abroad who requires a copy for binding, or for other purposes, is asked to make application therefor promptly to: The Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

NOTES.

Possible Delay in Publication.—In consequence of inconvenience which has occurred on one of the several premises at which this journal is produced, it is not unlikely that some delay in publication may arise this week. Under the circumstances we shall be glad if our readers will extend to us their usual kind consideration.

Labour Unrest Commissioners.—The following are the names of the Commissioners appointed to investigate labour unrest. They will begin work immediately:—

1. *North-East Coast.*—Sir Thomas Munro (chairman), Mr. P. Bright (Employers' Representative), Mr. H. Davies (Employés' Representative).
2. *North-West Coast.*—Judge Parry, Mr. John Smethurst, Mr. J. R. Clynes, M.P.
3. *Yorks. and E. Midlands.*—Sir G. Croydon Marks, M.P., Sir Maurice Levy, M.P., Mr. J. J. Mallon.
4. *West Midlands.*—Major J. W. Hills, M.P., Mr. J. W. White, Mr. A. G. Cameron.
5. *London and South-East.*—Judge O'Connor, Mr. Allan H. Smith, Mr. J. Voce.
6. *South-West.*—Mr. W. W. Mackenzie, K.C., Sir Alfred Booth, Mr. G. Chambers.
7. *Wales*, including *Monmouthshire.*—Mr. Lleufer Thomas, Mr. Thomas Evans, Mr. Vernon Hartshorn.
8. *Scotland.*—Sheriff T. A. Fyfe, Mr. Noel E. Peck, Mr. J. W. Ogden.

The Metric System.—At the annual meeting of the Incorporated Society of Inspectors of Weights and Measures, Mr. C. MacDonald, in a paper on "The Compulsory Adoption of the Metric System," said that at the beginning of the year the metric system was obligatory in trade in 38 countries, having a total population of 476,890,000. Its use was optional in 11 countries, having a total population of 727,233,000. The metric system might be described as the standard system of the world, and the development of foreign trade after the war would be facilitated by its adoption.

Mr. H. Cunliffe replied in a paper opposed to the change. He did not think compulsion should come except at the demand of the users of weights and measures. British weights and measures effectively satisfied the needs of international trade, and it was a matter for doubt whether the adoption of the metric system in this country would not assist Continental countries to enter the British market more than it would assist British merchants in entering theirs.

Mr. A. Granger submitted as a compromise that the pound weight should be made equal to the half-kilo, and the gallon equal to the half-decalitre. In each case it meant practically an increase of 10 per cent.—the new hundredweight to be 100 and the new ton 2,000 of these lbs. Measures of length should be left alone. A set of the new weights placed upon a shop counter would allow business to go on as usual simply by increasing prices 10 per cent. The retailers, a numerous class, desired no change. It would be comparatively easy to require that all goods sold by weight or measure should be sold in terms of weight and measure and no other. Thus at one stroke we should get rid of our sacks and sieves, our tods and trusses, our pots and pockets, and so on and so on. Further, corn would no longer be sold by a bushel, of which there are some 200 variations.—*The Times.*

At a meeting of the Electrical Section of the Newcastle-on-Tyne and Gateshead Chamber of Commerce it was decided to support the action of the Chamber of Commerce in urging that the Bill for the introduction of the metric weights and coinage be introduced into Parliament as soon as possible.

Lancashire and Cheshire Linking-up Scheme.—Communications have been received by the authorities interested, from the hon. secretary to the Committee for the inter-connection of Lancashire and Cheshire electricity supply systems, intimating that a Sub-Committee had under consideration details of a practical scheme, which will include the formation of a Central Joint Board and District Boards, and that a meeting of representatives of each group would in due course be summoned to consider such proposals.

Government and the A.S.E.—Dr. Addison, the Minister of Munitions, invited a large number of delegates from all parts of the country, representing the Amalgamated Society of Engineers, to meet him at the Central Hall, Westminster, on Wednesday, under the chairmanship of Mr. John Hodge, the Minister of Labour. Dr. Addison explained the position of the Government in relation to the Munitions of War Bill, the dilution of labour, and other matters.

Educational.—UNIVERSITY OF LONDON.—Arrangements have recently been completed for the establishment of a new department of technical optics, in connection with the Imperial College of Science and Technology at South Kensington. The department forms part of a larger scheme adopted by the London County Council in August last for the provision of instruction in this subject, including post-graduate and research work at the Imperial College, a trade school and senior day and technical courses at the Northampton Institute, and junior technical courses at two junior technical institutions, one in North London and one in South London. The Government, including the new Department of Scientific and Industrial Research and the Imperial College, has decided financially to support the Council's scheme, and all the necessary assents have been obtained. The amount of money immediately available is £4,000 a year for working expenses and £5,000 for equipment and more immediate necessities of the department. Mr. Frederic J. Cheshire has been appointed head of the new department, with the title Director of Technical Optics and Professor of Technical Optics at the Imperial College. He is the present president of the Optical Society.—*Daily Telegraph.*

The Earl of Halsbury, moving the adoption of the report and accounts at the annual meeting of the City and Guilds of London Institute, said that the need for technical training and the appreciation of its industrial value were increasing in many directions, and the Executive Committee of the Institute had already made preparation for a substantial development of chemical work, particularly in the direction of its industrial application, by the assignment of additional accommodation to the Department of Applied Chemistry at Finsbury. The available resources of the Institute's colleges were being utilised for technical purposes in every possible direction, and apart from naval and military work, this might have a far-reaching effect for years to come.

In order to make room for war staff, the offices of the Board of Education will shortly be removed to the Victoria and Albert Museum.

Institution and Lecture Notes.—American Institute of Electrical Engineers.—At the annual meeting on May 18th, Mr. E. W. Rice, jun., of Schenectady, N.Y., was elected president, with Messrs. F. Bedell, J. H. Finney, and A. S. McAllister as vice-presidents.

Illuminating Engineering Society (U.S.A.).—The Council has decided, in view of the national emergency, to abandon the 1917 Annual Convention. The papers will be published in the *Transactions.*

Association of Mining Electrical Engineers.—The last gathering of the session of members of the Midland Branch took place on June 2nd, when, by permission of the Stanton Ironworks Co., Ltd., an inspection was made of the electrical plant at the works at Stanton. Mr. F. Church was elected president for the coming year; secretary and treasurer, Mr. E. R. Hudson.

The Royal Society.—A special general meeting was held last week to consider certain changes made by the Council last year in Statute XII, relating to the election of Fellows. These changes empowered the Council to recommend for election—(*a*) Privy Councillors "whose election would assist the work of the Society"; and (*b*) "men distinguished in the scientific or educational service of the State, or by their services to science and its applications." The following resolution was carried:—"That this meeting is of opinion that the Council will serve the best interests of the Society by restoring Statute XII to the form it had before the change made in it by the Council on November 2nd, 1916, and by postponing further consideration of the statute relating to the election of Fellows until after the termination of the war."—*The Times.*

The Fellowship of the Royal Society is the "blue ribbon" of the scientific world, excelling in prestige all University degrees and similar marks of distinction; it would be a pity if this high standing were lowered by the election of mere politicians to the dignity of "F.R.S." Is this move on the part of the Council one of the results of the intimate relationship that has prevailed between the Society and the Government since the war revealed to the latter the fact that Science was indispensable to the State? One cannot touch pitch without being defiled, but, at least, let us preserve our premier scientific Society from unnecessary pollution.

Appointments Vacant.—Charge engineer for Maidstone electricity works; switchboard attendant and general assistant (35s.), for the Ascot District Gas and Electricity Co.; junior shift engineer (40s.), for the Islington B.C. Electricity Department; secretary to the borough electrical engineer (£200) and assistant to station superintendent (£200), for the Borough of Salford Electricity Department. See our advertisement pages to-day.

National Insurance (Unemployment) Acts, 1911 to 1916.—Contributions are payable in respect of:—

2,278 X. Workmen engaged in making or repairing time recorders and similar instruments.

2,286 X. Workmen engaged in the manufacture (including assembling) of turret clocks.

2,288 X. Workmen engaged in metal work and machine woodwork in connection with the manufacture of wind-screens for automobiles.

Contributions are not payable in respect of:—

2,277. Chauffeurs (other than those included under Decision A, 1,866 X, *Board of Trade Journal* of September 21st, 1916) engaged in driving and cleaning cars, and in doing occasional adjustments.

2,290. Workmen engaged in fixing automatic gas controllers in position in streets.

2,291. Workmen (other than those engaged in sawmilling, machine woodwork, or metal work) who are engaged in preparing railway signal posts, repairing railway station furniture, hammer shafts, brake sticks, &c., not intended for use in war.

The Electrical Industries on Tyneside.—At a meeting of the Electrical Section of the Newcastle and Gateshead Chamber of Commerce, the chairman, Mr. H. W. Clothier, presented a report on the scope of the Section, and it was agreed to take steps to make the Committee more fully representative of the electrical industries, and that a special meeting of all those connected with the industries of the district should be held on June 19th, at the Guildhall, Newcastle, to discuss matters of importance. With regard to the training of apprentices from Australia, it was agreed that the question involved in this procedure should be considered as soon as possible with regard to its effect on the British electrical industries, and that joint action of the sections of the industry in the district was desirable.

The British Empire Producers' Organisation.—At the luncheon meeting held yesterday at the Savoy Hotel, Monsieur C. Nabokoff, Councillor to the Russian Embassy, was the guest, and the chair was taken by Sir Charles C. Wakefield, Bart.

Legal.—AN IRISH ELECTRICAL ASSESSMENT.—In the King's Bench Division of the High Court of Ireland, Dublin, Justices Gibson, Madden and Kenny dismissed an appeal by way of case stated at the request of the Commissioners of Valuation, from the decision of the County Court Judge of Monaghan, reducing from £100 to £75 the valuation assessed on the buildings and plant of the Clones Electric Light and Power Co.

Electrical Trades Union.—At a meeting of the Birmingham Branch, last week, a Station Engineers' Branch of the Union was formed.

Accident.—Three men were injured through coming in contact with a live rail after a collision between two goods trains in a tunnel on the electric system of the Lancashire and Yorkshire line between Bury and Manchester.—*Times.*

Inquiries.—A correspondent asks for suggestions to prevent the transmission of noise from gearing on the top floor of a reinforced concrete building.

The address of agents of the United States Electric Tool Co. is asked for.

Makers of "King Eaton" small accumulators are asked for.

A correspondent wishes to know in what countries the bayonet type of lampholder is used to any extent.

Breaking Insulators.—At Dewsbury Police Court, last week, two lads, aged 16 and 15, were ordered to pay 16s. damage and 20s. 6d. costs between them, for wilful damage to telegraph insulators. Mr. E. H. Farrand, executive engineer for Leeds district of telephones and telegraphs, said that although the damage in his area in this way averaged £20 per month, he laid greater stress on the danger of communications being cut. The line was one of the most important in the country, and disaster might result from the interruption of messages sent by the military authorities.

Fatality.—A boy of 11, named John Prentice, who climbed a tree near Falkirk to obtain a good view of a passing aeroplane, slipped and fell among some electric wires, and was killed.—*Times.*

Belfast Association of Engineers.—On Thursday last the members of the above Society paid a visit to the Corporation electricity works under the guidance of Alderman Tyrrell and the city electrical engineer. Mr. Stanley Johnston, chairman of the Association, in thanking the latter gentlemen, drew attention to the inadequacy of the plant to supply the needs of the city, pointing out that if Belfast had had an Electrical Committee worthy of the name, they might have had one of the largest stations in the country. He complimented the city electrical engineer on having made £17,000 in the previous year from the inefficient scrap plant they had seen.

Evidently the visit was intended as an object lesson in "how not to do it," and, no doubt, the No. 1 engine room, with its 8—400-KW. sets still in use, was an excellent incentive to Mr. Johnston. The undertaking sold over 19 million units last year, although Belfast, with its shipyards and factories, ought easily to reach the 100 million mark.

British Battery Combine.—As our readers are well aware, one great advantage that industrial Germany has possessed over ourselves has been the fact that her manufactures were carried out on a larger scale and that there was a greater community of interests between trade concerns than has existed in this country. It has been recognised, therefore, that if we are to be in a position to compete with Germany after the war, some of our small concerns which are competing with each other in different branches of electrical work will doubtless find it to be correct policy to combine. The co-operative schemes for selling in the Russian market has been fully described in our columns. We now learn of an important manufacturing scheme which is being carried forward. We understand that the three battery concerns, the Hart Accumulator Co., Ltd., Pritchett & Gold and Electrical Power Storage Co., Ltd., and the D.P. Battery Co., Ltd., who made a joint offer (which has been accepted) for the shares in the Tudor Co. which were advertised for sale by the Public Trustee, are parties to the arrangement. Arrangements have been concluded for the managers of the Tudor Co. to remain in office, thus ensuring continuity of policy and practice in the business. As a natural outcome to the purchase of the Tudor shares, an announcement appears elsewhere in this issue to the effect that negotiations are in progress for an amalgamation of the four companies. It is hoped that a scheme will soon be evolved under which the united experience and connection of the various companies can be turned to the best account.

The Electric Vehicle Committee.—A meeting was held in London, on May 4th, 1917, when the officers of the Committee were re-elected for the current year and the annual report and accounts were submitted and approved.

The question of marking upon the batteries of electric vehicles the working limits for specific gravity was again under consideration, and in view of a report received from the Accumulator Makers' Section of the B.E.A.M.A., wherein objections were set forth to the proposal, it was decided to drop the matter for the present.

The secretary submitted the letters he had received from automobile manufacturers and electrical engineering firms in reply to the recent circular letters sent out to these firms setting forth the desirability of undertaking the manufacture of electric vehicles and equipments so soon as normal conditions return. Several firms had written stating that they were giving the question serious consideration.

London Electric Railways.—Compensation Claim.—Mr. A. Virgoe Buckland (of Messrs. Buckland & Browne, surveyors and land agents), has issued his decision as umpire in the claim for compensation, payable by the London Electric Railways, to the trustees of Mr. John Smith, in respect of certain property situate near to Victoria Street, Westminster, on the exercise by the railway company of their compulsory powers. The property consists of Nos. 29 and 31, The Broadway, which is leasehold, and of freehold land in Maundy Place. The umpire has decided that the amount of compensation payable is £4,588. At the hearing of the claim, on behalf of the trustees, Mr. J. H. Oakley valued the compensation at £5,776; Mr. W. H. Mills put the amount at £5,661, while Mr. A. L. Ryde (the arbitrator for the claimants), arrived at a total of £5,682. The value found on behalf of the Electric Railways by Sir Alexander Stenning, Mr. Samuel Walker (of Moorgate Street, E.C.), and Mr. Leslie Vigers (arbitrator for the company), was in the neighbourhood of £3,600.

Volunteer Notes. — County of London Engineer Volunteers (Field Companies).—Headquarters, Balderton Street Oxford Street, W.

Orders for the Week. By Lieut.-Colonel C. D. Clay, V.D., Commanding:—

Monday, June 18th.—Technical for No. 3 Company, Right Half Company, at Regency Street. Drill, No. 3 Company, Left Half Company. Signalling Class Recruits' Drill, 6.30.

Tuesday, June 19th.—Lecture, 6.30. Sergeant Instructor Higgs, "Pontooning.' Physical drill and bayonet fighting, 7.30.

Wednesday, June 20th.—Drill, No. 1 Company, Left Half Company.

Thursday, June 21st.—Drill, No. 2 Company, Left Half Company. Ambulance Class, 6.30. Signalling Class.

Friday, June 22nd.—Technical for No. 3 Company, Left Half Company, at Regency Street. Drill, No. 3 Company, Right Half Company. Recruits' Drill, 6.30.

Saturday, June 23rd.—N.C.O.'s Class, 2.30, under Company Commander Hyman and the Instructor of Musketry.

Sunday, June 24th.—Parade Clapham Common (Tube Railway), 9.45 a.m. for work at Bombing School. Uniform. Rations to be carried.

Macleod Yearsley, *Adjutant.*

The Birmingham Electrical Engineers, a unit of the V.T.C., have just been "recognised" and re-christened by the Army Council. In future they will be known as the Warwickshire Volunteer Engineers.

Formed in November, 1914, the corps has trained over 600 men, who have joined the Army and Navy. The present strength is about 250, and the men are rendering important service in connection with the scheme of home defence.

Recruits are invited, full information being obtainable from the Adjutant, Mr. S. T. Pemberton, 8, Church Street, Birmingham.—*Birmingham Daily Gazette.*

Strong Lightning.—During a recent storm at Oldham a woman was killed by a brick dislodged from the chimney of the Bell Mill, which had been struck by lightning. At the inquest it was stated that bricks from the chimney were hurled over the roofs of houses and fell about the street, narrowly missing several other people. The engineer at the Bell Mill said the lightning conductor at the mill had acted, for the earth at the bottom had been displaced, but the electric current must have been so strong that it was more than an ordinary conductor could deal with. To us it looks as if the conductor was improperly earthed.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The Motherwell T.C. has agreed to advance the salary of the electrical engineer by £50 to £350, with a further advance of £50 in May, 1918.

By 16 votes to 10, the Doncaster Town Council has resolved against a recommendation of a committee that the salary of the electrical engineer and tramways manager, Mr. E. S. Rayner, be increased by £50 per annum.

It appears from a Dublin newspaper report that the Belfast Corporation has revised the decision of the Electricity Committee respecting the appointment of a mechanical engineer for the electricity works, and has appointed Mr. J. R. Davison, of Manchester, who has had practical experience with the type of boilers in use at the Belfast works.

The Sheffield Electric Supply Committee has decided in favour of the salary of Mr. S. E. Fedden, general manager and engineer, being increased from £900 to £1,000 per annum, with two further annual increments of £100 each; also that the salary of Mr. H. E. Yerbury, deputy general manager and engineer, be increased from £600 to £700 per annum.

Walsall Corporation has declined to release Mr. Horsfield, the tramways manager, for service in the Shipyard and Labour Department of the Admiralty, being of opinion that his services are indispensable to the tramways undertaking.

The General Purposes Committee of Wolverhampton T.C. has endorsed a recommendation of the Electricity Committee that the salary of Mr. S. T. Allen, electrical engineer, be increased from £600 to £800 per annum, as from June 1st, 1917.

Mr. J. B. Feltham holds the position of waterworks engineer at Mexborough, not that of engineer-in-charge of the waterworks, as stated last week.

General.—On Saturday evening last, a large number of the staff and friends of Messrs. Albert Lee & Co., Ltd., assembled at the Holborn Restaurant to bid "farewell and God-speed" to Mr. Thomas Harris, the managing director, Mr. C. W. Chambers, the secretary, and Mr. J. E. Allden, the manager, on their joining the Army. The chair was occupied by Mr. E. Pattisson, assisted by Mr. A. Harris, brother of the managing director, who will fill his place till he returns, and among the guests were Mr. Takata and Mr. Morris, of the National Carbon Co., U.S.A. In the course of the evening complimentary speeches were made by the chairman and others. A gold wrist watch was presented by Mr. Morris, together with a cheque from Messrs. A. Lee & Co., to Mr. Harris. Mr. Chambers, who goes to the R.N.A.S., and Mr. Allden were also the recipients of wrist watches.

Mr. Arthur J. Cridge, of the British Westinghouse Electric & Manufacturing Co., Ltd., Trafford Park, Manchester, was married on Tuesday last to Grace Gertrude, younger daughter of Mr. and Mrs. S. G. P. Heath, of Putney. The ceremony took place at St. Stephen's Church, East Putney, and Mr. and Mrs. Cridge afterwards left for Cornwall, where the honeymoon will be spent.

The marriage took place at Dartford, on May 25th, of Mr. Melbourne Dewhurst, M.Sc., A.M.I.E.E., of Colne (Lancs.), and Miss Rebecca Stidolph, of Dartford.

At the annual meeting of the American Institute of Electrical Engineers on May 18th, the Edison Medal was presented to Mr. Nikola Tesla in recognition of his early original work in polyphase and high-frequency electric currents.

The American Institute of Radio Engineers has awarded the "medal of honour" for 1917 to Edwin H. Armstrong for his work in connection with regenerative amplification and oscillation by means of the vacuum-tube relay.

Roll of Honour.—Private H. Bentley, of the East Lancashires, who is wounded for the second time, was employed by Mr. Fairhurst, electrical engineer, of Darwen.

Captain Rupert Stanley, R.E., who has been decorated by the French Commander-in-Chief with the insignia of the Order of the Legion of Honour, is Professor of Electrical Engineering in the Belfast Municipal Technical Institute, which post he has held since 1903. He has done excellent service at the Front in connection with electrical and wireless work, and has been twice mentioned in dispatches.

Corporal J. H. Noble (20), West Riding Regiment, reported missing, was employed by Messrs. J. H. Taylor & Co., electrical engineers, Huddersfield.

Private C. M'Donald, Gordon Highlanders, who has died of wounds, was an electrical inspector with the Aberdeen Corporation.

Private R. W. Noble, 10th Canadian Regiment, who has died of wounds, was a Morecambe man, who left this country seven years ago, and became an electrical engineer on the Canadian Pacific Railway, stationed at Calgary, Alberta.

Private W. Naylor, employed in the Bradford City electricity department, is reported missing.

Private J. Barker, Loyal North Lancashire Regiment, posted missing in October last, now officially reported killed

in action, was employed by Messrs. Dick, Kerr & Co., Ltd., Preston.

Sapper J. TARPETH, Wessex Engineers, who has died of wounds received in action, was on the Bath electricity works staff.

Private W. A. KNIGHT, South Staffs. Regiment, who has died of wounds, was in the winding department of the B.T.H. Co., at Rugby.

Sergeant HANDYSIDE, Royal Artillery, who was with Messrs. Willans & Robinson, Ltd., Rugby, has fallen in action. In 1915 he was awarded the D.C.M. and the French Medaille Militaire for distinguished valour.

Rifleman C. G. READ, K.R.R., killed in action, was on the staff of the B.T.H. Co., of Rugby.

Corporal J. HIRONS, R.F.A., who was an employé, at Rugby, of the B.T.H. Co., has been wounded for the second time, and seriously.

Private L. ROGERS, London Regiment, who has fallen in action, was on the clerical staff at the Ilford U.D.C. electricity works.

For gallantry in action, the Military Medal has been awarded to Corporal J. CARTLEDGE, formerly with the Potteries Electric Traction Co. Under heavy fire he laid a cable by compass in an unreconnoitred bit of country, and maintained the line through an attack.

Lieutenant J. G. KIRKUP, Northumberland Fusiliers, who was an electrical engineer with the Consett Iron Co., has been awarded the Military Cross.

Mr. P. W. HOOL, Army Ordnance Corps, formerly on the staff of the Bromley (Kent) Electric Light Co., has been mentioned in dispatches by Sir Douglas Haig.

Captain GUY CAMPBELL, Machine Gun Corps, formerly with Messrs. W. H. Allen, Son & Co., Ltd., Bedford, has been accidentally killed whilst supervising the throwing of live bombs. He had won the Military Cross.

Corporal E. RONDLE (Machine Gun Brigade), formerly in the general office of the India Rubber, Gutta Percha & Telegraph Works Co., Ltd., Silvertown, has been wounded.

Obituary.—MR. G. J. HARFORD.—The death has taken place at Birkdale, Southport, of Mr. G. J. Harford, who was in business as an electrical engineer in Liverpool. He was 48 years of age.

ALDERMAN W. F. COTTON, M.P.—Alderman W. F. Cotton, M.P., Dublin, who passed away on Friday last week in his 86th year, was for a considerable period a director of the Dublin United (Electric) Tramways Co., and was largely interested in the gas industry, having been chairman of the Alliance and Dublin Consumers' Co., prior to which he had held various offices under the company, and, earlier still, had been lighting superintendent of the city under the Corporation.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

L. Weekes, Ltd.—Particulars of £3,000 debentures, created May 26th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

W. H. Allen, Son & Co., Ltd.—Further charge dated May 29th, 1917 (supplemental to mortgage dated November 21st, 1916, securing £103,980), to secure £50,000. Property charged: As in principal mortgage. Holder: H.M. Secretary for War.

Longford Wire Co., Ltd.—Charge on leasehold Longford Wire Works, dated May 25th, 1917, to secure two annual rents of £48 and £52 payable for residue of 999 years from 1900, subject to proviso that charge shall cease when buildings of double the value of such rents have been erected on the land. Holder: Sir Gilbert-Greenall, Bart., C.V.O.

Brompton & Kensington Electricity Supply Co., Ltd. (25,913).—Capital, £300,000 in 20,000 pref. and 40,000 ord. shares of £5 each. Return dated April 12th, 1917. 5,966 pref. and 34,034 ord. shares taken up. £5 per share called up on 5,966 pref. and 33,034 ord.; £195,000 paid; £5,000 considered as paid on 1,000 ord. Mortgages and charges: Nil.

British Insulated & Helsby Cables, Ltd. (52,285).—Capital, £1,000,000 in 100,000 pref. and 100,000 ord. shares of £5 each. Return dated April 9th, 1917. All shares taken up. £572,675 paid on 74,470 pref. and 40,065 ord.; £427,325 considered as paid on 25,530 pref. and 59,935 ord. Mortgages and charges: £700,000.

Alderley & Wilmslow Electric Supply Co., Ltd. (47,663).—Capital, £30,000 in 1 shares (10,000 pref.). Return dated May 16th, 1917. 15,009 ord. shares taken up; £15,009 paid. Mortgages and charges: £15,000.

Alert Electrical Co., Ltd. (78,971).—Capital, £2,000 in £1 shares. Return dated February 28th, 1917. 708 shares taken up; £708 paid. Mortgages and charges: Nil.

British Electric Transformer Co., Ltd. (76,351).—Capital, £200,000 in £1 shares (100,000 pref. and 100,000 ord.). Return dated April 12th, 1917. 61,988 pref. and 85,498 ord. shares taken up; £1 per share called up on 52,764 pref. and 9,529 ord., and 12s. 6d. per share on 14 ord.; £62,301 15s. paid; £85,179 considered as paid on 9,224 pref. and 75,955 ord. Mortgages and charges: Nil.

Bromley (Kent) Electric Light & Power Co., Ltd.—Capital, £75,000 in £5 shares. Return dated April 16th, 1917. All shares taken up; £75,000 paid. Mortgages and charges: £64,363.

Camborne Electricity Supply Co., Ltd. (57,950).—Capital, £10,000 in £1 shares. Return dated April 25th, 1917. 607 shares taken up; £605 paid, leaving £2 in arrears. Mortgages and charges: Nil.

City of Carlisle Electric Tramways Co., Ltd. (62,601).—Capital, £60,000 in £1 shares. Return dated March 5th, 1917. All shares taken up; £60,000 paid. Mortgages and charges: £57,500.

CITY NOTES.

British Electric Traction Co., Ltd.

The report of this company, as published in the financial Press, states that the gross profit for the year amounts to £226,744, compared with £244,064 for 1915-16. After deducting the general expenses and the amount written off sundry assets, viz., £26,772, there remains £199,971, plus £86,428 brought forward. Deducting debenture stock interest, amounting to £91,249, there remains £195,150, which the directors recommend should be applied thus:—To reserve £15,000, dividend of 6 per cent. on the cum. part. preference stock £42,764, dividend of 3 per cent. on the ordinary stock £39,787, to be carried forward £97,598. The aggregate receipts of the tramway, omnibus, and electricity supply companies in which the company is interested showed an increase, which was largely counterbalanced by the continued increase in the wages paid and the cost of all material. Many of the companies have increased the amounts placed to their renewal accounts and reserves, and while their financial position has been thereby improved the dividends distributed have been less than they would otherwise have been. The increase in the receipts has consequently not been reflected in this company's revenue from investments, and the net profit shows a reduction of £9,197 compared with the previous year. The amount standing to the credit of the reserve account at March 31st, 1916, was £410,000. It is proposed to increase this amount by £15,000, to be transferred from revenue as shown by the accounts. The investments now stand at £4,285,578, and yielded a revenue of £205,258, representing an average of 4.79 per cent. for the past year on the amount at which they appear in the balance sheet.

Lisbon Electric Tramways, Ltd.

Mr. L. BREITMEYER presided at the annual meeting, on June 6th. He said that the difficulties had been more acute in 1916 than in 1915, but the report was not altogether unsatisfactory. The only gratifying feature in the accounts was the expansion of traffic revenue, there being an appreciable increase (£24,000), which, unfortunately, was swallowed up entirely by the expenditure, which had grown at a rapid rate, the working costs exceeding those of 1915 by £36,000. The speaker referred to the unprecedented cost of supplies. Rails, which normally cost £6 per ton, were now five times that figure. Coal in pre-war times was 21s. to 22s. per ton delivered in their power house; a month ago it was £6 10s., and now it was not procurable under £10 per ton, and that with difficulty. In other words, the dividend was evaporating in the smoke-stack. The chairman discussed the opposition that they met with when they tried to raise the fares. They felt that it would be neither good finance nor prudent in the shareholders' interests to pay even the smallest dividend under the circumstances.

The Armorduct Manufacturing Co., Ltd.—It will be observed from an announcement appearing in our advertisements to-day that the business of the above company is being offered, under the Trading with the Enemy Amendment Act, for sale by tender as a going concern. Tenders must be sent to the Controller, Mr. J. Paterson, 1, Walbrook, E.C., by June 28th.

Automatic Telephone Manufacturing Co., Ltd.—The preference share and transfer books will be closed from 18th to 25th inst., for preparing dividend warrants on the preference shares for the half-year.

North Metropolitan Electric Power Supply Co.—After putting £10,542 to renewals reserve, 6 per cent. dividend and a bonus of 8s. per share are to be paid, carrying forward £1,775.

Cleveland & Durham County Electric Power Co.—The complete accounts of this company for the year 1916 occupy several pages of the *London Gazette* for June 12th.

China and Japan Telephone & Electric Co.—Dividend, 10 per cent., placing to reserve £26,736, and carrying forward £3,938.

Tramways & Light Railways Estates, Ltd.—For 1916 the dividend is 3 per cent., carrying forward £626.

Manila Electric Railroad & Lighting Corpn.—Dividend, 1½ per cent. (1.50 dol. per share) for the quarter to June 30th.

Madras Electric Supply Corpn., Ltd.—Six per cent. preference dividend, less tax, for 1916.

Barnsley & District Electric Traction Co., Ltd.—Dividend 6 per cent., carrying forward £1,014.

Peterborough Electric Traction Co., Ltd.—After paying the preference dividend, £742 is carried forward.

Longford Wire Co., Ltd.—The capital of this company has been reduced from £100,000 to £69,999.

Edison Accumulators, Ltd.

For 1916, the directors report that, in spite of the abnormal difficulties occasioned by the war, satisfactory progress has been made.

The charges for freight, insurance, clearance, delivery, and dues have been excessive, and several consignments have been lost at sea. From this cause, and the serious delays due to the lack of available shipping, a large number of important orders are being carried forward to the next financial year. Tipping wagons fitted with Edison accumulators have been supplied to many of the principal municipal authorities throughout the country with satisfactory results, and a considerable number of delivery vehicles are in regular use by first-class business houses in London and the provinces. Owing to the reliability of these delivery vehicles, and their economy in working, repeat orders are constantly being received, and one of the most important firms in London has 80 such vehicles in daily use. The demand for Edison accumulator self-propelled trucks, which are coming into general use for handling heavy goods in railway stations, depôts, and factories, is continually increasing, and the company has on hand Government contracts of considerable importance. Although the balance sheet shows profits sufficient to meet the accrued interest upon preference shares after providing for reserve, it is proposed that payment should be deferred, an arrangement which will be advantageous to the shareholders in the near future.

The annual meeting of the company was held at Duke Street, S.W., on June 5th. Lord Montagu of Beaulieu, who presided, said that the profit for the year, exclusive of provision for excess profits tax, was £4,614. The tax mentioned, as at present arranged, operated especially to the disadvantage of companies, such as theirs, which had to build up new business. Even in the case of older companies it prevented provision being made for the severe competition inevitable after the war, but, while admitting the necessity for taxing large profits as a fruitful source of revenue, young companies should be leniently treated. Their freight and insurance difficulties had greatly increased during the year. They had paid over £18,000 in freight and war risk insurance, which normally would have cost about one-eighth of this figure, and they had been hampered by the formalities introduced by various Government departments. Considering the shortage of petrol, it was in the national interests that the company should receive more consideration from the departments concerned, especially from the Priority Committee. At present they had some £100,000 worth of unexecuted orders, and had paid many thousands of pounds for vehicles which were lying in New York, all of which would save labour, petrol, and expense if only they could be put to work. The value of orders received during the year was no less than double that of the previous year. Harrods, J. Barker & Co., Whiteleys, Selfridges, and the Hovis Co. were constantly extending their fleet of vehicles. Harrods alone had 80 in use. The Midland Railway Co. were now using in London and provincial towns over 50 Edison battery vehicles, and they found that they could make their deliveries at a lower cost than before either with horses or petrol lorries. The company were now considering considerably increasing their fleet of electric vehicles, and other railway companies would undoubtedly follow suit. Co-operative societies at Glasgow, Leeds, Blackpool, Leicester, &c., had adopted the company's system, and the collection of house refuse and other municipal work had brought more orders than the company could handle. Sheffield Cleansing Department had now 10 electric vehicles in service, and many other cities were also employing them. Another branch that they had developed was the use of industrial self-propelled trucks in factories, and for handling luggage, &c., in railway stations. With a business increasing by leaps and bounds when it was impossible to raise new capital, it was absolutely necessary to conserve the profits in order to extend the business. When the war was ended the results would readily attract the capital necessary to enable the company to operate on a scale commensurate with the demand that would undoubtedly exist.

Great Northern Telegraph Co., Ltd., of Denmark.

At the annual meeting, held at Copenhagen on May 25th, Consul-General W. Weimann, who presided, said that their war difficulties had increased considerably since the last meeting, but they had been able to maintain communication over the cables. Ten of their cables in European waters had suffered 15 interruptions, and 29 breaks had occurred in nine cables in the Far East. They had not yet been able to repair their cables in the Baltic which had been interrupted since November, 1914. The Wladiwostock and Kiachta routes had been maintained in very good working order by the Russian Telegraph Administration, but traffic over these lines between Europe and the Far East had decreased considerably. The concession granted to the company by the French Government for landing and working the cables between Denmark and France expired last year, but had been provisionally prolonged without alteration. Negotiations for a definitive arrangement would have to be entered into after the war. Rates over the cables in the Far East had been reduced for certain classes of traffic with Japan. The rates over the Iceland cable had been materially reduced as from January, 1917. The arrangement with the Danish Government for the erection and working by the company of two local wireless stations in the Faeroe Islands was finally concluded about a year ago. The installations (by the Marconi Co.) were recently so far completed as to admit of an *ad interim* service being started. On January 1st, 1917, a serious fire occurred at the company's buildings in Shanghai, in which are also housed the Eastern Extension and Commercial Pacific Companies. The damage was extensive, and many instruments were destroyed. The staff so quickly restored communication that the effect of this serious misfortune was hardly felt by the public. Certain rooms in the building had been fitted up as temporary instrument rooms, and office accommodation had been secured outside, pending the rebuilding of the premises. The speaker referred to the increasing difficulties of management as follows:—

The most serious of these difficulties is that connected with the maintenance of the cables. Nearly all the cables belonging to the company in Europe cross the continually expanding minefields and prohibited areas, and should breaks occur in such places it may prove impossible to have the cables repaired.

We have also met with difficulties in supplying our stations with instruments, telegraph paper, &c., &c., owing to the scarcity of material, diminution of transport facilities, and to the export and import prohibitions in force to practically all countries.

The measures taken by the belligerents have also affected our staff arrangements. Thus it proves now and then difficult to obtain the necessary permission to appoint Danish operators to our stations in the countries involved in the war, and in England we have had to resort to a large extent to female labour, especially to replace our British employés who, voluntarily or by order, join the Colours. In Petrograd the military authorities have as a measure of precaution, gradually displaced our Danish and Russian operators, and have in their stead appointed Russian Government employés to work the instruments. This measure was adopted through no fault of the company.

The financial results of the year's working were so satisfactory that the directors came to the conclusion that they could propose the distribution of a total dividend and bonus of 24 per cent., or 2 per cent. more than for the year 1915. They, however, warned the shareholders that the extraordinary prosperity which the company was now enjoying would disappear when peace was concluded, or very soon after. As the cost of living, the taxation, and the working expenses, which were at present very high, and increasing almost from day to day, were not likely to become normal for some years after the conclusion of peace, a considerable decrease in the net receipts of the company might be looked for. In the circumstances they had strengthened the dividend equalisation fund by adding to it £55,556. The renewal fund for cable steamers was not sufficient to cover the cost of replacing the two oldest of the company's steamers, even at prewar prices, and much less so at the present enhanced prices, which would probably obtain for a long time. £27,778 is therefore added to this fund.

Calcutta Tramways Co., Ltd.—Sir H. Kimber, at the annual meeting, said that the revenue account showed an increase of 6 per cent. on the traffic receipts of 1915, and of 5 per cent. on those of 1914, which included seven months of pre-war takings. The Indian working expenses increased by £2,484. There was a decrease of £1,488 in power expenses due to the operation of the new generating and sub-station plant, but traffic expenses were up £842, and maintenance and repairs by £3,708, due to enhanced cost of materials. It was proposed to revert to the practice of paying the dividend on the ordinary shares, free of tax, after payment of the present final dividend.

Winnipeg Electric Railway Co.—Owing to very substantial increases in the cost of all materials, as well as to the serious competition of the jitneys in the city, the results for the year have been disappointing. For these and other reasons a discontinuance of dividends for the time being would strengthen the financial position of the company and more quickly guarantee an earlier date for the resumption of such dividends.

New General Traction Co., Ltd.—For the year ended March last, the revenue was £19,481. Profit £10,649, plus £7,901 brought forward. The directors recommend a dividend of 4 per cent. (less tax), and carry forward £8,070. The Norwich Electric Tramways Co. paid a dividend of 3 per cent., being the same rate as for the previous year. The Douglas Southern Electric tramways system is still closed down on account of the war. The income received from the Philadelphia undertaking amounted to £14,053.—*Financial Times.*

South Metropolitan Electric Tramways & Lighting Co., Ltd.—Total revenue for 1916, £68,793, compared with £69,281 for 1915. Placed to reserve, £4,000; dividend, 5 per cent. on preference shares, £3,478; carried forward, £400. The gross receipts from tramways and light railways increased by £27. The gross receipts from the electricity supply were £17,467, compared with £17,242. Total units sold, 1,267,631, compared with 1,195,371. Lighting and power units sold increased by 6 per cent and number of consumers by 3 per cent.

Rangoon Electric Tramway & Supply Co., Ltd.—Gross profits for 1916, £65,829. After paying debenture interest, preference dividend, and providing for reserve, depreciation, &c., 4 per cent. is to be paid on the ordinary shares, free of tax, leaving £2,902 to carry forward.

Northern Counties Electricity Supply Co., Ltd.—The accounts for 1916 show a gross profit of £12,104, against £11,624, and after paying debenture and other interest the debit balance of £6,654 brought forward is reduced to £5,815. —*Financial Times.*

Birmingham and District Power & Traction Co., Ltd.—After placing £5,000 to reserve and paying 4½ per cent. on the preferred ordinary shares, £5,570 is to be carried forward.

Lima Light, Power & Tramways Co.—Net profit, £P128,799, plus £P80,396 brought forward. After paying dividends and providing for general amortisation fund, reserve, new works, &c., £P2,742 is to be carried forward.

STOCKS AND SHARES.

TUESDAY EVENING.

THE fine news which Sir Douglas Haig sends does much to infuse cheerfulness into the Stock Exchange markets. There remains a certain amount of nervousness in regard to Russia. This nervousness plays its part in laying a restraining hand upon business; but the advance on the Western Front has sufficiently encouraged confidence to bring a good deal of money into the House, and to revive the speculative interest in those markets where anything like animation prevails.

Accordingly, the groups in which iron and steel shares, rubber, explosive, and other similar industrial companies are located cannot complain of the volume of trade they are called upon to handle; although, at the same time, the purely investment stocks are rather neglected, and the man who is urged to buy War Loan is tempted to reply that, with war expenditure at its present rate, he is a little bit reluctant to embark freely upon securities of the fixed-interest and gilt-edged order, lest there should be competition later on that will reduce present prices and give him opportunities for using his money to greater advantage. A somewhat specious argument this, especially when it is recalled that Mr. Bonar Law hinted plainly that, so far as the Government were concerned, better terms were not likely to be offered in the future than those which accompanied the 5 per cent. War Loan.

Tube railway stocks are better, Metropolitans, Districts, and Underground income bonds all showing rises on the week, though the last-named touched 84¼ before reacting a little to 84, which still leaves an improvement of a point. The shilling shares are better at 5s. 9d.; and this section shows up well as a whole in consequence of the expectation, referred to in our last notes, that before long there will be a re-arrangement of fares following upon the example recently set by the L.C.C. tramways.

The various tramway companies have been in the limelight, owing to the issue of several of the reports. The principal is that of the London United Tramways, which will probably come as a blow to stockholders. The price of the debenture stock is 37 to 39. The London United last year did not make enough money to pay its debenture and administration expenses. The debenture interest for July cannot be paid, and last Tuesday a receiver for the debenture-holders was appointed by the Court. Two well-known trust companies have summoned meetings, with a view to securing a strong debenture holders' committee. There is rather over 1½ million pounds sterling of first debenture stock outstanding, to say nothing of loans from the London & Suburban Traction Co. and the Underground Electric Railways.

There is little satisfaction to be obtained in jobbing backwards, though, at the same time, the temptation is great to point the finger to the numberless warnings of years ago at what seemed to us the inevitable end to the over-capitalisation of this company. Hard as it may seem, the only way to put the London United Tramways upon a sound footing once more will be to apply the pruning knife drastically to the capital account. No other course is open that we can see. The company has a large and important system, with plenty of business to its hand. Under vigorous and progressive management, on a reasonable amount of capital, the company should do well.

A large number of the shares in the company are owned by the London & Suburban Traction; and the latter, in its report, shows that it has just earned its preference dividend. The amount available for distribution is £84,800, against £83,600 in the previous twelvemonth. The company is also largely interested in two omnibus concerns, as well as in the London United and Metropolitan Electric Tramways. The Metropolitan last year paid 1 per cent. on its ordinary shares, but this cannot be repeated in respect of the past 12 months, although there was a small improvement in the gross earnings. Heavier working expenses are recorded in the case of all three companies. These are disappointing results; and it looks as though the rise in operating expenses should have been met earlier by re-arrangement of fares.

The electric lighting market is steady. The London shares are still mostly in demand, and a fair business is being transacted in the issues of the City companies. The North Metropolitan Electric Power Supply has declared a dividend of 6 per cent., together with a bonus of 8s. per share, the dividend being the same as that for 1916, but the bonus being additional this year. The preference shares are quoted at 17s. 6d., and the 5 per cent. mortgages at 85s.

The South Metropolitan Electric Tramways & Lighting Co. proposes to pay 2½ per cent. on the 6 per cent. preference shares, making 5 per cent. for the year—a reduction of 1 per cent. as compared with the previous period—and to carry forward £400, as against £800 brought into the accounts. Digestion of the British Electric Traction report has had little effect upon the prices of the stocks. The ordinary changed hands a few days ago at 33, the preference and 5 per cent. debenture stocks at 75½, and the 4½ per cent. second debenture stock at 65½.

British Columbia Electric Railway stocks are still flat. the preference at 57½ being 2½ down. We understand that important documents are on the way to this country in regard to the competition which is threatened in 1919 by the Municipality; and until these arrive it is not likely that any further steps will be taken. Brazil Tractions are better at 47½. Anglo-Argentine Tramway first preference have again given way, being quoted no better than 2⅝.

The industrial section is the firmest of them all, and the feature is furnished by Edison Swan £3-paid shares spurting to 15s. 9d., a rise of 5s. 9d. on the week. The 4 per cent. debenture stock is also better. Babcocks are good at £3. Callenders and General Electric preference both advanced. British Westinghouse preference lost 1/16 of its recent rise.

Marconis are an active and a strong market. It is confidently expected that the Government will pay the company a bonus shortly; and on the strength of this, the parent shares at one time touched 3 5/16, while the preference were 2⅝. The latter reacted to 2⅜ and the others to 3⅛, showing, however, substantial improvement on balance. The cable market is good throughout, the principal rise being secured by Indo-Europeans at 51, these being 30s. up. Globe ordinary gained 5s., and, in the lower-priced shares, West India and Panamas are 1/16 higher. There is little floating stock on offer.

Notwithstanding the decline in the price of rubber to 2s. 9½d. per lb., there is a good deal of business doing in the leading shares. Hopes are being fanned that some sort of action will be taken in relief of the excess profits duty, having regard to the pressure of the tax upon the younger companies as exemplified in a number of the recently-issued reports, these showing many instances of undoubted hardship. The market in the explosives continues active, in view of the Government's consent to a big combine; while most of the armament shares which go with those of the iron, coal, and steel group, are decidedly strong on buying that emanates mainly from the provinces.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price June 12, 1917.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	9	6½	—	£6 18 6
Charing Cross Ordinary	5	5	8½	—	7 2 10
do. do. do. 4½ Pref.	4½	4½	8½	—	6 18 6
Chelsea	4	3	2¾	—	5 4 4
City of London	8	8	12	—	6 13 4
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10⅜	—	6 11 9
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	7	10	5½	—	5 11 7
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8½	—	5 6 8
Metropolitan	8	8	2⅜	—	6 0 0
do. 4½ per cent. Pref.	4½	4½	8½	—	7 4 0
St. James' and Pall Mall	8	8	6⅜	+ ⅛	6 3 1
South London	5	5	2½	—	7 5 6
South Metropolitan Pref.	7	7	21/-	—	£6 13 4
Westminster Ordinary	7	7	5⅜	—	6* 1 9
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	98	—	6 2 0
do. Def.	33.6	1½	x2½	—	6 13 4
Chile Telephone	8	8	7	+ 3/16	£6 14 4
Cuba Sub. Ord.	5	5	8	—	6 5 0
Eastern Extension	8	8	18⅜	—	*5 17 6
Eastern Tel. Ord.	8	8	189	—	*5 15 1
Globe Tel. and T. Ord.	7	7	15⅜	+ ¼	*5 9 10
do. Pref.	6	6	10⅜	—	5 18 5
Great Northern Tel.	22	22	86½	—	6 0 7
Indo-European	13	13	51	+1½	5 7 5
Marconi	10	10	3⅛	+ ⅛	3 1 6
New York Tel. 4½	4½	4½	99	—	4 11 0
Oriental Telephone Ord.	10	10	2⅜	+ ⅛	4 4 1
United R. Plate Tel.	8	8	6⅜	+ ⅛	*5 18 6
West India and Pan.	6d.	6d.	1⅜	+ 1/16	2 2 1
Western Telegraph	8	8	14	—	*5 14 4
HOME RAILS.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	24⅜	+1	4 0 10
do. District	Nil	Nil	16½	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	1⅜	—	Nil
do. do. "A"	Nil	Nil	5/9	+3d.	Nil
do. do. Income	6	5	84	+1	*5 19 1
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	2⅜	— ⅛	9 11 4
do. 2nd Pref.	5½	—	2⅛	—	—
do. 5 Deb.	5	5	66½	+ ½	7 10 5
Brazil Tractions	4	4	47½	+ ⅛	—
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	57½	— 2½	8 13 10
do. do. Preferred	Nil	Nil	57½	—	Nil
do. do. Deferred	Nil	Nil	33½	—	Nil
do. do. Deb.	4½	4½	58½	—	7 1 8
Mexico Trams 5 per cent. Bonds	Nil	Nil	37	—	Nil
do. 6 per cent. Bonds	Nil	Nil	50	—	Nil
Mexican Light Common	Nil	Nil	14½	—	Nil
do. Pref.	Nil	Nil	24½	—	Nil
do. 1st Bonds	Nil	Nil	87½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	3	+ 3/32	5 0 0
British Aluminium Ord.	7	10	27/3	—	7 6 10
British Insulated Ord.	17½	20	19⅜	—	7 18 5
British Westinghouse Pref.	7⅜	7⅜	2⅜	— 1/16	6 6 4
Callenders	20	20	18½	+ ⅜	7 5 6
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	22	22	8⅜xd	—	6 10 2
Edison Swan, £3 paid	—	—	15/9	+5/9	Nil
do. do. fully paid	—	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	71½	+1	5 12 0
Electric Construction	7½	—	1	—	7 10 0
Gen. Elec. Pref.	6	6	10	+ ½	6 0 0
do. Ord.	10	10	15	—	6 13 4
Henley	25	25	15½	—	8 1 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12¾	—	*8 5 0
Telegraph Con	20	20	37½	—	*6 8 2

* Dividends paid free of income-tax.

INDUCTION METHODS OF FAULT LOCALISATION.

By H. E. BLAKE, A.M.I.E.E.

From time to time in the electrical Press, the induction method of finding faults in buried cables with a search-coil and telephone is recommended. The suggestions made for carrying out this test invariably involve a considerable weight of apparatus to create an artificial load for passing through the fault. The following arrangement reduces the size of the whole of the apparatus required to a box, measuring not more than 9 in. × 5 in. × 7 in., together with a light search-coil, thus converting an unwieldy equipment into a cheaply constructed and conveniently portable one. A G.E.C. medical coil, No. 3,020, and a 4-volt 20-ampere battery of accumulators are mounted together in a box. Accumulators are preferable to dry cells, as their superior capacity copes with the fault resistance more successfully. The space below the medical coil can be utilised for notes, also for keeping a Sullivan wireless telephone receiver of 5 ohms resistance. When fault-finding apparatus is needed it is usually required without a moment's delay, and a great point is gained by having everything available in a compact form, instead of gathering the apparatus laboriously together after the emergency has arisen. With regard to the wireless telephone receiver, permission to purchase this must be obtained from the Postmaster-General, due to the war. This will be given in due course, on receipt of a guarantee that it is to be used for fault-finding and not for wireless telegraphy. The search coil should be wound with 100 turns of cotton-covered bell wire, on a light triangular wooden frame 6 ft. at the base and 3 ft. in height, with a cross arm for carrying it over the ground.

The accompanying diagram explains the method of procedure, and the apparatus may be used in the following ways:—

1. *To Locate a Fault to Earth.*—See diagram.

2. *To Trace the Run of a Buried Cable.*—Attach coil to one end of the cable, as shown in the diagram, and earth the other end of the cable. The sound in the wireless telephone receiver will be loudest when the triangular search coil is held parallel with, and directly above, the line of the cable.

3. *To Check the Position of a Fault Located by a Drop of Potential or a Loop Test, when Services are Tapped off the Cable under Test.*—A drop of potential or a loop test will only locate a fault accurately, if it is on the main; the result will show on the main, though the fault may really be on a service. It can be decided whether the fault is on the main or on one of the services by attaching the coil as in the diagram, and holding the triangle parallel with the services in the neighbourhood of the fault, as shown by the drop of potential or loop test. A loud sound in the receiver over a service will locate the fault on that service. The drop of potential test, in conjunction with the telephone test, gives very accurate results. By utilising two entirely different methods of fault finding, the result is invariably correct when they confirm one another.

It is often desired to find an earth on a L.T. network without making the faulty cable dead, where power consumers, doctors, &c., are connected to it. In these cases a condenser of 2 mfd. capacity must be inserted between the pressure lead of the induction coil and the cable under test. The condenser is necessary, because, though the main under test be at earth potential, if the fault should be in a consumer's premises, and he should remove it by switching off, the supply current would spoil the apparatus without a condenser in circuit. It will be found that the superimposed current will only be audible in the telephone on comparatively small networks, such as those on an A.C. system of distribution, where a faulty district can be isolated on one group of transformers. The make and break of the induction coil must also be slowed up by lengthening the arm of the interrupter, otherwise it is not possible to distinguish the superimposed interrupted current from the periodicity of the A.C. supply. When the network is too large, the superimposed current disperses itself over the whole area to complete its circuit through all the weak points, wherever they may be, including consumers' wiring, and the position of the fault under investigation is not found. It is far preferable to make the cable under test dead if possible, as it needs some practice to distinguish the sound of the supply current from that of the superimposed current. The test is rendered still more difficult by the noise of passing traffic in crowded thoroughfares, the beat of a petrol engine being specially confusing. Also on D.C. networks, any X-ray apparatus connected to the mains will be found to produce a sound in the telephone practically identical with that of the induction coil.

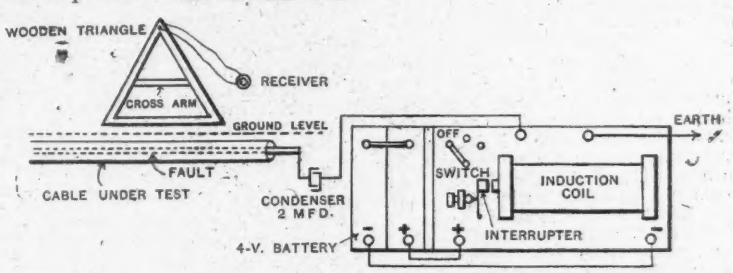

Diagram of Connections for Telephone Method of Fault-finding.

The sound in the receiver becomes faint at the fault for lead-sheathed cables or for cables in metal pipes, and ceases at the fault for V.B., when the triangle is carried along above the route of the cable.

THE MORE RECENT APPLICATIONS OF ELECTRICITY IN THE PRESENT WAR, ESPECIALLY IN THE TREATMENT OF DISEASES AND WOUNDS ARISING THEREFROM.

By WARRANT OFFICER W. LEEMING, A.M.A.

[The following paper was awarded the "Cecil" Medal and prize of £10 in the competition advertised by the Dorset Field Club in our issue of December 8th, 1916. Mr. Leeming is the officer in charge of the Massage and Electrical Department of the Monte Video Convalescent Camp, Weymouth.—Eds. Elec. Rev.]

Introduction.—In dealing with this subject, it will be necessary to state clearly the author's experience, which commenced some eight years ago with a thorough training and diploma in the North of England, five years' private practice in Australia, during which the author was two years Honorary Masseur and Electro-Therapeutist to the Melbourne Hospital, and more recently, since the beginning of the war, in the same capacity at the Australian Command Depôt, Monte Video Camp, near Weymouth, Dorset.

Upwards of 3,000 patients have come under the author's observation during the past two years, several hundred of whom have been under personal treatment.

In the course of the paper, the author proposes to detail various definite cases which have successfully yielded to methods of electrical treatment which before the present war were unknown.

For the purposes of the paper, the subject will be dealt with under the following headings:—

1. Radiant Heat, Röntgen Rays, and Electric Vibration.
2. Paralysis in its various forms.
3. Ionisation—Destruction of Organic Matter—Septic Wounds.
4. Faradisation on Relaxed Muscles.
5. Sciatica, Treatment of.
6. Rheumatism, Treatment of.
7. Synovitis, Treatment of.

1. *Radiant Heat, Röntgen Rays, and Electric Vibration.*—The application of each of these treatments may be classed as secondary compared with the closer application of electricity, as in faradisation and galvanisation, which in many cases is vitally important for a partial or complete recovery of the patient.

The therapeutic value of radiant electric heat in convales-

cent hospitals has been unquestionably proved since the present war.

Neuritis, muscular rheumatism, synovitis, and periostitis, all of which diseases are continuously dealt with, show a marked improvement within one to two weeks. The main advantage of the dry electric heat produced by carbon lamps, over vapour and other forms of heat, is that the acceleration of the heart and the respiratory system is slight in comparison with the more exhausting Turkish bath, for instance.

Radiant heat can be arranged so as to increase the vascular circulation in very small areas; the pores of the skin are opened, and the nerve centres beneficially influenced, as proved by the fact that patients frequently become sleepy when undergoing radiant heat treatment. The result is the stimulation of the superficial tissues, and the elimination of foreign matter, mainly through the pores of the skin, but also by increased absorption in the deeper tissues.

It is important in most cases of wounds which have destroyed a certain area of skin that the scar tissue is not exposed to the full rays of the lamps. The fact of the scar tissue being without pores renders that part incapable of eliminating moisture. The result is that the sweat collects under the tissue and forms a water blister, which naturally necessitates the building of new scar tissue, to replace the affected part. A strip of lint placed over the scar is sufficient to prevent scar-blistering, without interfering with the therapeutical effects of the electric heat.

The author has seen cases of acute synovitis of the knee, and of fibrositis, which have shown remarkable improvement in a few weeks due to treatment with radiant heat, ionisation, and massage.

Many forms of radiant heat baths are now made, ranging from the small type for local affections to the cabinet bath for body treatments, the results of which are precisely similar. An excellent type of apparatus suitable for most local applications is shown in fig. 1.

The number of carbon lamps (16 c.p.) may vary between six and 12, according to the heat required, and the bath is

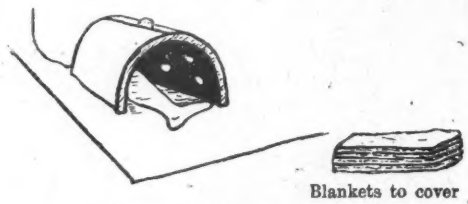

Fig. 1.—Radiant Heat Bath.

so constructed that the greatest amount of heat is retained inwardly. A temperature of 250 deg. F. may thus be reached without unduly raising the temperature of the other parts of the body not under treatment.

The uses of the Röntgen rays are well known in connection with the present war. Apart from the importance of X-rays in accurately revealing the position of fractured bones, splinters of bone, &c., they are of great value in locating other solids, such as shell splinters.

A remarkable instance came under the author's treatment a few weeks ago. A soldier in the 1st Battalion, Australian Infantry, received two machine-gun bullets, which entered the left side of the neck. One of the bullets found its way out at the other side of the neck. The two bullets had entered in *exactly the same point*, consequently the medical men considered it as a through and through wound, but could not understand why the left arm was paralysed.

It was two months after the wound was received that an X-ray photograph was ordered, and showed the second bullet resting above the left shoulder. The subsequent operation proved that this bullet has been causing pressure on the brachial plexus of nerves, as the day after the removal of the bullet the patient was able to move his arm. He has since practically recovered the complete use of his arm with galvanisation.

The therapeutical effect of Röntgen rays is of considerable importance in the treatment of skin eruptions, ulcers, &c. The influence on the vitality of the tissues is very similar to radiant heat, light, and other applications of electricity. In weak doses, the rays are organically stimulative, with no appreciable reaction; but in stronger doses there may be a destruction of tissue if applied continuously.

Electric vibration is a mechanical device capable of setting up, by electric motor, a vibration varying from 250 to 1,000 vibrations per minute. This is applied through a rubber pad for preference. The effect is stimulative and contractive. The depth of the tissues which undergo stimulation is directly proportionate to the speed of the vibration. As a stimulant for weak and relaxed muscles, its use is of some value, also in increasing local circulation to an affected part. Vibration is sometimes useful in cases of nerve lesion caused by a wound.

2. *Paralysis in its Various Forms.*—The cases which are cited are both varied and remarkable. They may be divided mainly into three headings, namely:—

(*a*) Cerebral.
(*b*) Spinal.
(*c*) Peripheral.

(*a*) Cerebral injuries are not very common, thanks to the latest headgear worn in the trenches, but cases of hemiplegia do occur as the direct result of a head wound which has pierced the skull.

The usual treatment for these cases is "make-and-break" galvanisation applied on the affected limbs. Good results are invariably found by the local or bi-polar method, rather than by direct application to the brain, or uni-polar method, which is trying to the patient. The safest and best plan, in the author's experience, is to find out the particular group of nerves which are affected, and apply the anode or positive pole to the plexus, previously ascertained. A good method is to damp thoroughly eight thicknesses of plain lint and apply the electrode through this. A bandage is quite sufficient to keep the pad and electrode in position. Make the cathode the labile pole, and apply through a small circular pad electrode, for preference, to the various motor points. The motor points are the points of entrance of a nerve which governs a muscle, and their positions are more or less definite. The following diagram (fig. 2) gives an idea of the motor points of the arm.

It is important to locate these points in the treatment of hemiplegia in order to give the full amount of stimulation

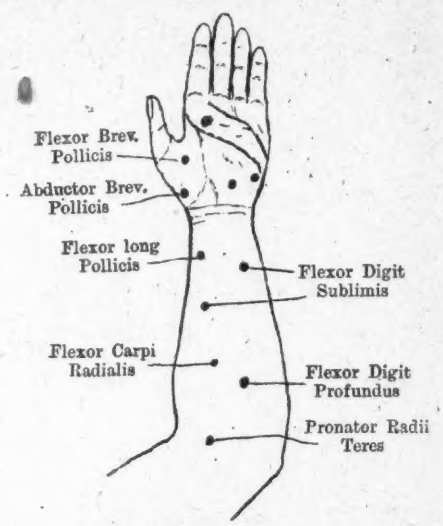

Fig. 2.—Motor Points of the Arm.

to the nerves which are injured. For ordinary purposes an alternation of about 30 seconds applied in this way will give very beneficial results.

Cases occasionally occur of men affected with cerebral disturbance, or partially hysterical condition, caused other than by wounds; shell-shock and over-strained condition of the nerves often gives rise to cerebral trouble, the result being a lack of co-ordination between the nerve centres and the muscles.

This is more frequent in young soldiers between the ages of 17 and 21. The following is the case of a boy of 18, in the 22nd Battalion, A.I.F., who had a bullet wound through the forearm, which showed every symptom of "drop wrist." It had been splinted, and he had become convinced that he could not move his wrist. Tests for reaction of degeneration showed that the nerves were really in perfect condition, which pointed to a lack of co-ordination with the brain. The author applied faradisation as a nerve stimulant, and also to demonstrate the excitability to the patient, and by inducing mental control perfect use of the hand was restored in a week. The patient in question was able shortly afterwards to wheel a barrow filled with coal.

(*b*) Spinal paralysis, or paraplegia, is chiefly caused in the present war by shell-shock, but may also in some instances be due to a wound. The paralysis always appears below the seat of injury or lesion. These cases are often more obstinate than cerebral injuries from the electro-therapeutic standpoint. Their treatment is practically the same as in cerebral injuries, and is usually somewhat prolonged, according to the extent of the injury, but experience shows that electricity is the best treatment for the ultimate cure of paraplegia.

(*c*) Peripheral paralysis is the most common form dealt with in connection with wounds. Injuries take place in all parts of the body by gun-shot wounds, which in about 75 per cent. of cases cause some injury to the course of a nerve, resulting in loss of power or sensation.

Often in cases of peripheral paralysis neuritis of the nerve is set up, causing much pain to the patient. Great relief has been obtained by the bi-polar application of the constant galvanic current for 15 minutes. In passing, it is necessary to mention that in all cases of pain caused by wounds galvanisation has remarkably sedative effects.

A wound through the upper arm in many cases injures the musculo-spiral nerve, the well-known result of which is "wrist drop." The nerve in some cases is completely severed, and, of course, it is useless to give electrical treatment until an operation to join the severed ends has been performed. But in many cases the nerve is still intact, though badly injured, and it is in these cases that electricity is of the utmost value in restoring the life of that nerve.

The faradic, which is the induced, interrupted current, has been found by the author to have very beneficial results in certain cases. Care has to be taken that reaction of degeneration is not present in the nerve, as permanent harm may be done by the unscientific use of faradisation.

Good results have been produced by the application of slow faradisation and "make-and-break" galvanisation on alternate days. A definite instance of the success of this treatment came under the author's personal treatment at the beginning of October last. The patient in question was a sergeant in the 60th Battalion, Australian Infantry, and a native of Geelong, Victoria. His wound was received on July 19th, 1916, and the bullet passed through the back of the knee, as illustrated in fig. 3.

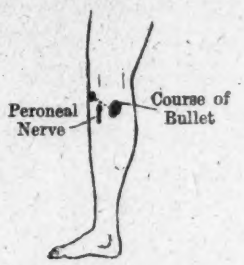

FIG. 6.

Evidently serious injury had taken place to the deep peroneal nerve, causing "drop foot," and it was thought in the Birmingham Hospital that the nerve was completely severed.

As stated, he came under treatment at Weymouth at the beginning of October. In less than one month of the treatment just detailed, used in the bi-polar method, slight movement of the foot was observed. Within two months the patient could walk, practically without a limp, with support only from a plaster of paris mould on the foot, and could take several steps without support of any kind. He sailed for Australia about December 12th; consequently, he was only under treatment at Weymouth for a little over two months.

3. *Ionisation — Destruction of Organic Matter — Septic Wounds.*—The process of ionisation is the science of introducing into the human system by electrolysis the ions or atoms of certain medicines, chosen for their curative or stimulative effect. It is of the greatest importance in connection with wounds, and there is still a field for much development in this particular branch of the science.

Very frequently cases are sent for treatment with wounds in a very bad condition. A piece of cloth, a poisoned piece of shell, or other matter completely foreign to the system, may be the direct cause of the trouble. Inflammation is set up, which may or may not spread to other parts, and large deposits of foreign matter form in the region of the wound.

The ionic medication of *sodium chloride* has been found to give excellent results. The following method has been used very successfully in the author's practice, that is, by applying eight thicknesses of plain lint, soaked with a saturated solution of sodium chloride, and afterwards squeezed, to the actual wound. The anode, or positive pole, is applied directly into the open wound by a suitable electrode, preferably small. The electrode should be firmly bound to the lint with a dry bandage. The cathode, or indifferent pole, may be applied similarly at a convenient point, and the galvanic current introduced for 15 to 20 minutes. The strength of the current may vary between three and 20 milliamperes, according to the convenience of the patient. The results of this method of treatment are both rapid and almost painless. It may easily be said to have superseded the clumsy and discomforting methods of fomentations, which increase the sensitiveness of the surrounding tissues. On the other hand, the galvanic current allays the pain at the same time that it helps to destroy organic matter.

Since August last the author has given the ionic medication of sodium chloride to upwards of 50 patients, who had suffered in different ways with septic wounds, and, without exception, they have yielded to the above treatment in less than two weeks from the commencement. The length of time in healing these wounds varies according to the area affected by the poisoning.

Not infrequently pieces of cloth, also bone, are brought to the surface by ionisation.

The author has made certain definite discoveries in the treatment of the trophic ulcers, which often arise from "trench feet." These ulcers show great obstinacy to the ordinary modes of treatment, but yield slowly and definitely to the ionisation of *zinc sulphate*. The solution is best introduced at the negative pole, and the same process may be followed as in the ionisation of septic wounds, with the difference of polarity only.

It is advisable, after the ulcer has healed, to continue the treatment for some time to assist the nutrition of the surrounding tissues, and so prevent the ulcer recurring elsewhere.

The ionic medication of sodium salicylate in cases of joint rheumatism has been found of some benefit.

4. *Faradisation on Relaxed Muscles.*—It invariably happens that when a limb has lost its functional activity, muscular weakness and relaxation occurs in a more or less acute form. In such cases faradisation has been found distinctly beneficial in toning the muscle fibres by contraction.

Wounds frequently cause a spastic condition of a certain group of muscles, such as the flexors of the leg, the extensors being correspondingly stretched; faradisation is an extremely useful adjunct to the massage treatment for troubles of this kind in inducing a counter-contraction of the stretched muscles against the spastic muscles. A similar effect is produced in cases of sprains and dislocations, which, incidentally, are fairly numerous in convalescent camps, and it is probable that the toning effect of the faradic current extends to the ligaments as well as to the surrounding muscles.

5. *Sciatica, Treatment of.*—Galvanisation has long been acknowledged as a powerful agent in effecting a cure of sciatica. The form of sciatica which soldiers contract on active service, through exposure, is similar in many respects to that from which civilians suffer. But in addition to the ordinary form of swelling and contraction in the nerve, caused by cold and damp, peripheral neuritis of the sciatic nerve occasionally establishes itself as the direct result of a wound in the buttock.

Cases are not uncommon in which a bullet has actually been resting on the nerve, and has set up the ordinary symptoms of sciatica, together with partial paralysis. The author has found the ionic medication of sodium salicylate, applied at the negative pole, to be of distinct benefit in treating these cases. The bullet itself is, no doubt, influenced by the electric current and attracted towards the surface of the skin; the stimulating and soothing effect of this treatment is most marked. The length of time taken to restore the tone of a nerve in this way varies according to the extent of the injury sustained, but in all cases the pain is quickly reduced.

One notable effect of sciatica is a complete loss of sensation in certain parts of the leg, usually on the front and outer side of the tibia and fibula bones, and the dorsal side of the foot. Massage and faradisation has been found the most efficient treatment for this loss of sensation. Radiant heat proves equally useful, however, in certain cases where the stimulation of the skin is required.

Skilful massage alone will produce reasonably good results, but in all cases of sciatica, probably more than half the time may be saved by adopting electric stimulation, together with manipulations which give tone and increased circulation to the surrounding muscles. Neither treatment is complete in itself, but if both are skilfully applied, success is practically assured.

6. *Rheumatism, Treatment of.*—Muscular rheumatism and rheumatoid arthritis are the most prevalent forms of this complaint which arise with troops on active service. Many men have hereditary tendencies to rheumatism, which is aggravated by the exposure under active-service conditions, and it is by no means easy to effect a lasting cure by massage, electro-therapeutics, or hydropathy in this class of patient. A number of cases respond readily to persistent treatment, but one difficulty, from the operator's standpoint, is that the patients themselves do not take sufficient care of their health whilst under treatment. In addition, there is some danger of reaction resulting from treatment, but, despite the possibilities of these counter-actions taking place, many lasting cures have been achieved.

In muscular rheumatism, massage is equally as important as electricity. Radiant electric heat, followed by massage, may be said to be the ideal treatment in these cases. Relief is certain at all times, and a large percentage of definite cures can be effected.

Chronic rheumatism in the joints is best treated by the ionic medication of sodium salicylate, 2 per cent. solution, applied through the affected joint, followed by massage, and being supplemented occasionally by radiant heat. The results are usually slow, and at times rather disheartening.

7. *Synovitis, Treatment of.*—This disease is fairly common among soldiers on active service, the bursæ at the knee and elbow being mainly affected. A wound is frequently the cause of synovial trouble, and in all cases of wounds involving a joint, a certain amount of laceration of the membrane invariably happens.

The value of radiant electric heat in these cases has been previously mentioned, and the more common form of synovitis, which many athletes develop, yields, in a very short time, to the same treatment.

Conclusion.—So far, the author has not referred to the applications of sinusoidal current, but a brief reference here may not be out of place. The rise and fall of the sinusoidal current, being less marked than that of faradism, makes this current more suitable for the testing of reactions of degeneration, and for stimulation. Whereas strong faradism produces a state of tetanus in the muscles, it is quite absent in the

application of the sinusoidal current. The therapeutic effects of the faradic and sinusoidal currents are almost identical.

The use of the sinusoidal current is not general in military convalescent camps, for two reasons, namely: (*a*) Because the alternating current necessary is not often available, and (*b*) because the sinusoidal plant is considerably more expensive than the faradic.

The scope of this paper has been confined to the author's personal observation and experience in the science of electrotherapeutics. Great progress has been made in this branch of hospital work since the beginning of the war, and there still remains a large field for research and experimental work in the treatment of diseases and wounds.

AN A.C. BRIDGE METHOD OF COMPARING INDUCTANCES.

By T. PARNELL, M.A.

(*Abstract of paper read before the* PHYSICAL SOCIETY.)

THE simple Maxwell inductance bridge cannot be used conveniently for the comparison of fixed inductances on account of the tedious double balance necessary, though by reason of its simplicity and symmetry the bridge has much to recommend it. By making use of a current detector whose deflections depend on the component of the current in quadrature with the E.M.F. applied to the bridge, it is possible to make the condition for no deflection depend either chiefly on the inductances or chiefly on the resistances.

The arrangement of the bridge is shown in fig. 1. In series with the bridge is placed either a non-inductive resistance, R, or a condenser, K. If R, r, and s are all large compared with p, q, g, $P\omega$ and $Q\omega$, it will be shown that, with R in circuit, the balance depends chiefly on the inductances P and Q, and that with K in circuit the balance depends chiefly on the resistances.

With R in circuit, s is adjusted for no deflection; this gives an approximate balance for the inductances. Then, with K in circuit, q is adjusted for no deflection; this gives an approximate balance for the resistances. The process is repeated, and after a few balances values of s and q are obtained that give a balance with either R or K in circuit, in which case the bridge is completely balanced, and $P/Q = p/q = r/s$.

The first few balances need only be made roughly, and the whole process can be carried out very quickly: when the apparatus is adjusted, an unknown inductance can be balanced against a standard to one part in a few thousand in a few minutes.

As detector a sensitive moving-coil galvanometer and rotating commutator may be used. In this case the commutator is mounted

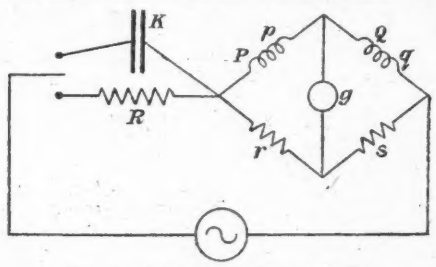

FIG. 1.—A.C. INDUCTANCE BRIDGE.

on the axle of the small alternator or rotary converter that supplies the bridge current, and the brushes of the commutator are adjusted till no deflection is produced, when the E.M.F. used on the bridge is applied through the commutator to a high non-inductive resistance in series with the shunted galvanometer, thus showing that the commutator is in quadrature with the E.M.F. When the commutator is thus adjusted the deflection of the galvanometer is approximately proportional to the component of the current in quadrature with the E.M.F. applied to the bridge.

A more convenient detector is the Sumpner reflecting electrodynamometer, manufactured by Paul. The suspended coil moves in the field of a laminated iron electromagnet excited by a field winding with a large number of turns: the resistance of this field winding is small compared with its reactance, and therefore the total flux through the field coils is approximately in quadrature with the applied E.M.F. The flux density is sensibly constant throughout the air-gap and proportional to the total flux; when, therefore, the moving coil is connected across the bridge, and an E.M.F. in phase with the E.M.F. used for the bridge is applied to the field coils, the mean torque on the moving coil is approximately proportional to the component of the current in quadrature with the bridge E.M.F.

If the mutual inductances between the various conductors and also their capacities and the inductances of R, r, and s are negligible, the final balance is independent of wave-form and frequency. The preliminary balances depend on wave-form and frequency. An approximate knowledge only of the conditions for these preliminary balances is required.

Measurements of a number of coils with various values of the voltage and of R, K, and r gave results consistent within 1 in 1,000. Owing to the presence of R or K, it is necessary to use fairly high voltages in order to keep up the sensitiveness.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

7,651. "Automatic electrical control for trains." G. D. K. MOSS. May 29th.
7,656. "Telephone transmitters." B. A. PILKINGTON. May 29th.
7,659. "Electric generator and dynamo." O. J. REILLY. May 29th.
7,676. "Magazine telegraph transmitters." L. M. POTTS. May 29th.
7,679. "High-speed electric locomotives." BRITISH THOMSON-HOUSTON Co. F. W. CARTER. May 29th.
7,680. "Transmitting valves for wireless telegraphy." F. P. DRIVER AND OSRAM-ROBERTSON LAMP WORKS. May 29th.
7,681. "Transmitting valves for wireless telegraphy." C. H. HARVEY AND OSRAM-ROBERTSON LAMP WORKS. May 29th.
7,682. "Transmitting valves for wireless telegraphy." O. DURDLE AND OSRAM-ROBERTSON LAMP WORKS. May 29th.
7,683. "Electric plug couplings." W. R. CLEMENTS & W. T. HENLEY'S TELEGRAPH WORKS Co., LTD. May 29th.
7,684. "Electric secondary or storage batteries." O. OLDHAM. May 29th.
7,702. "Electric generators." SOC. DE PARIS ET DU RHONE. May 29th. (France, May 26th, 1916.)
7,710. "Electrically-operated contact-breaker for battery ignition system magnetos, &c." W. H. NIX. May 30th.
7,712. "Overwinding switch for electric cranes, &c." S. H. HEYWOOD AND S. H. HEYWOOD & Co. May 30th.
7,718. "Rectifying interrupters for X-ray purposes." A. E. DEAN. May 30th.
7,730. "Voltage regulators." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.). May 30th.
7,735. "Arc lamp for medical and surgical purposes." E. E. GREVILLE. May 30th.
7,739. "Magneto-ignition apparatus for internal-combustion engines." AKT. GES. BROWN, BOVERI ET CIE. May 30th. (Germany, May 30th, 1916.)
7,749. "Magnetos." H. GUILLOU. May 30th. (France, January 27th, 1915.)
7,771. "Generating." S. J. WILLEY. May 31st.
7,814. "Process of obtaining nitrogen from air." ELEKTRIZITATSWERK LONZA. May 31st. (Switzerland, June 17th, 1916.)
7,820. "Miners' safety lamps." R. LAMBOURNE. May 31st.
7,821. "Generation of mechanical power by different currents." D. SUCHOSTAWER. May 31st.
7,826. "Electric fuse box." A. L. HOLMAN. May 31st. (Denmark, July 21st, 1916.)
7,836. "Sparking plugs." L. BLAIZOT & M. BROLLY. May 31st.
7,846. "Dynamo-electric machines." SUBMERSIBLE AND J. L. MOTORS, LTD., AND H. K. WHITEHORN. May 31st.
7,847. "Sparking plugs for internal-combustion engines." W. O. KENNINGTON. May 31st.
7,875. "Commutator brush assembly for internal-combustion engines." F. VALAINT. June 1st.
7,882. "Electric insulating materials." A. R. MULLER. June 1st.
7,900. "Telegraph, &c., poles." W. G. YOUNG. June 1st.
7,925. "Electric arc lamps, including flame arcs." S. E. R. BEECROFT. June 2nd.
7,934. "Hanging-straps for electric cars, &c." M. YAMASAKI. June 2nd.
7,943. "Wireless signalling systems." BRITISH THOMSON-HOUSTON Co. AND GENERAL ELECTRIC Co. June 2nd.
7,953. "Electrical measuring instruments." G. A. CHEETHAM. June 2nd.
7,957. "Electric spark-gap protective devices." G. GILES. June 2nd. (Switzerland, June 26th, 1916.)

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

4,938. ELECTRIC TIME SWITCHES. A. M. Coates. April 4th, 1916. (106,108.)
5,091. ELECTRIC MAKE-AND-BREAK DEVICES. E. C. R. Marks (American Model & Instrument Co.). April 6th, 1916. (106,111.)
5,884. ELECTRICALLY-OPERATED TEMPERATURE ALARMS. J. P. M. A. Struyven. April 25th, 1916. (106,117.)
6,467. DYNAMO-ELECTRIC MACHINES. J. W. Howard. May 5th, 1916. (106,118).
7,244. ELECTRIC FURNACE ELECTRODES. V. Stobie & S. Davenport. May 22nd, 1916. (106,152.)
9,804. HAND OR PORTABLE ELECTRIC LAMP. H. S. Gulston. July 12th, 1916. (106,025.)
10,228. PROCESS OF ELECTRO-PLATING NON-CONDUCTING SUBSTANCES WITH COPPER. U. Unno. July 20th, 1916. (106,184.)
10,328. CONTACT SCREW OF THE ARMATURE OF FIELD TELEPHONE INDUCTION COILS. H. C. Back. July 22nd, 1916. (106,029.)
10,919. MAGNETO-ELECTRIC MACHINES. F. R. Simms. August 2nd, 1916. (106,195.)
11,968. ELECTRIC GLOW LAMPS AND THE LIKE. C. O. Bastian. January 26th, 1916. (Divided application on 1,271/16.) (106,036.)
13,482. MULTIPLE FUSE PLUGS. Six-In-One-Fuse Co. January 18th, 1916. (103,469.)
13,593. ELECTRIC RESISTANCE FURNACES. J. C. Landtmeters. September 25th, 1916. (106,044.)
13,816. SYSTEMS OF ELECTRIC DISTRIBUTION. British Westinghouse Electric and Manufacturing Co. October 7th, 1915. (101,711.)
15,429. MEANS FOR EXPEDITING AND SAFEGUARDING RAILWAY TRAFFIC. H. A. Thompson. October 30th, 1916. (106,051.)
16,359. CONTACTS FOR ELECTRIC SWITCHES, AND OTHER ELECTRICAL APPARATUS, AND THE MODE OF AND MEANS FOR MOUNTING OR SUPPORTING SAME. A. Crawford & W. Preston. May 15th, 1916. (Cognate application, 15,033/16.) (106,054.)
18,649. ELECTRO-MECHANICAL MAKE-AND-BREAK MOVEMENT FOR ELECTRIC CIRCUITS. F. de Cannart d'Hamale. December 30th, 1916. (106,064.)

1917.

3,765. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. A. G. France. March 15th, 1917. (106,256.)